This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

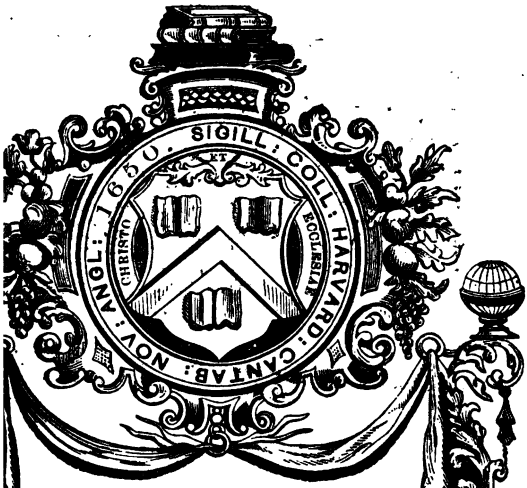
We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

5258.66



THE GIFT OF

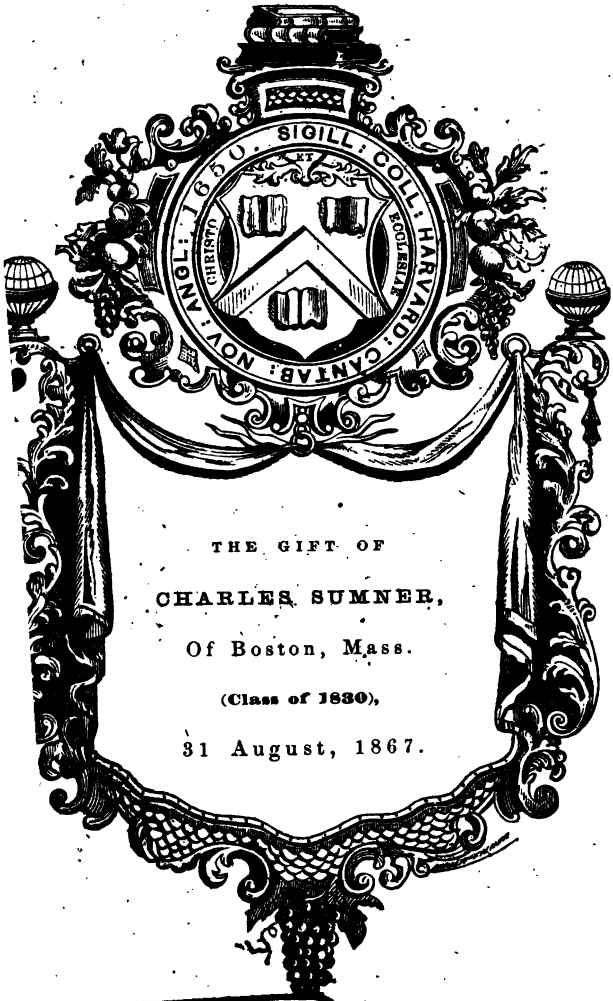
CHARLES SUMNER,

Of Boston, Mass.

(Class of 1830),

31 August, 1867.

Var 5258.66



THE GIFT OF

CHARLES SUMNER,

Of Boston, Mass.

(Class of 1830),

31 August, 1867.

E
4'3"
C
D
8'
3'7"
3'9"
B
7' 2"
4' 1'5"
9'

A TREATISE

ON

INTRENCHMENTS:

BY

FRANCIS J. LIPPITT,

BREVET BRIGADIER-GENERAL UNITED STATES VOLUNTEERS, LATE COLONEL SECOND CALIFORNIA INFANTRY; AUTHOR OF "TACTICAL USE OF THE THREE ARMS."

NEW YORK:

D. VAN NOSTRAND, PUBLISHER, 192 BROADWAY.

1866.

War 5258.66

1867, Aug. 31
Gift of
Hon. Chas. Sumner
(D. C. 1830)

Entered according to Act of Congress, in the year of our Lord 1866,

BY FRANCIS J. LIPPITT,

In the Clerk's office of the District Court of the United States, for the District of Rhode Island.

TO

D. H. MAHAN, LL.D.,

PROFESSOR OF MILITARY ENGINEERING, ETC., ETC.,

IN THE UNITED STATES MILITARY ACADEMY
AT WEST POINT,

THIS BOOK IS RESPECTFULLY INSCRIBED

BY HIS FORMER PUPIL,

THE AUTHOR.

TABLE OF CONTENTS.

		PAGE
I.	Of Intrenchments, Generally	1
II.	Materials Used for the Parapet	5
III.	Of the Profile	9
IV.	Of the Plan	17
V.	Of Bridge-heads	38
VI.	Of the Armament	44
VII.	Of Traverses and Defilation	48
VIII.	Auxiliary Materials Used	50
IX.	Auxiliary Obstructions and Defences	55
X.	Of the Laying Out and Profiling of the Work	63
XI.	Of the Site	75
XII.	Works for the Defence of a Town or City	79
XIII.	Lines of Intrenchment	90
	A. Continuous Lines	90
	B. Lines with Intervals	92
XIV.	Attack on Intrenchments	108
	A. The Bombardment	109
	1. *Planting of Batteries*	110
	2. *The Fire*	113
	B. The Assault	116
	1. *When to Assault*	116
	2. *Formation for Assault*	120
	3. *How to Assault*	123
	C. Attack on Lines of Intrenchment	132
XV.	Of the Defence	138

INTRENCHMENTS.

I.—Of Intrenchments Generally.

1. An intrenchment, or field-work, consists of a mound, generally of earth, called a *parapet*, and of a trench, or *ditch*, which is usually in front of the parapet. These are prolonged either in a single line, straight, or curved, or in several lines, meeting at one or more angles; according to the form or plan adopted for the intrenchment.

2. An intrenchment has *three objects:* First, To cover the assailed from the assailants' missiles;

Secondly, To interpose an obstacle to the assailants' closing on them; and

Thirdly, To make the fire of the assailed more effective; and this it does in two ways:

(1.) By keeping the assailants exposed to it at short range, for more or less time.

(2.) By enabling the assailed to fire with a more steady and accurate, and therefore deadlier aim. This results, first, from their having, in the parapet, a rest for their weapons; and secondly, from the greater degree of coolness and deliberation natural to men who feel themselves covered from fire.

3. When an intrenchment is so constructed as to secure these objects, it gives the assailed *great odds in their favor.*

At Bunker Hill, some two thousand raw militiamen repulsed two assaults of four thousand British regulars, killing and wounding one third of their number, and retiring then only from the want of ammunition.

At Savannah, in 1779, three thousand British, behind intrenchments, repulsed eight thousand French and Americans, with a loss of eight hundred and seventy-eight, the British loss being trifling.

At Warsaw, Kosciusko, with ten thousand Poles, behind intrenchments, repulsed sixty thousand Russians and Prussians.

At New Orleans, on the 8th of January, 1815, four thousand Americans, mostly raw volunteers, behind their intrenchments, repulsed the attack of eight thousand British veterans; whose loss was two thousand killed and wounded, while the American loss was only thirteen.

In December, 1862, during our late war, Colonel Morgan, stationed at Davis' Mills with two hundred and fifty cavalry only, was attacked by the Confederate General Van Dorn with a force of several thousand men. The day before, Morgan, hearing of their approach, with the help of railroad ties and cotton bales, had converted an old sawmill into a blockhouse, and had thrown up an earth-work round the base of a mound. These were the only defences, and were begun and completed on

the same day, by eleven o'clock of the night preceding the attack. The Confederates were repulsed with the loss of several hundred killed and wounded, while our loss was only three wounded.

At Fort Donelson, in February, 1863, our troops, behind their intrenchments, repulsed several brigades of Confederates with a loss of nine hundred men; our loss being only thirteen killed and fifty-one wounded.

In the Crimean war, Sebastopol, defended principally by earth-works, was captured only after an eleven months' siege by powerful armies.

Finally, in the late war, Richmond, by means of intrenchments, successfully defied the efforts of large armies to capture it for the space of three years; falling into our hands at last only in consequence of its evacuation.

4. Intrenchments are not only used defensively, but may sometimes have a direct and decisive *offensive* effect.

At the opening of our Revolutionary War, Washington occupied Dorchester Heights, commanding Boston on the south, and began to fortify them. It was this that compelled the British army to evacuate the city.

5. Intrenchments often come powerfully *in aid of military operations*, whether tactical or strategic.

At the battle of La Rothière, in 1814, where Napoleon had to fight one hundred thousand men with only thirty-two thousand, he had made Marmont strengthen the left wing with some field-works. This wing, though

numbering only four thousand men, was thereby enabled to withstand for two hours the most desperate attacks from vastly superior forces, and then to fall back in good order to a position previously designated.

In 1809, by means of earth-works thrown up near Presburg, and garrisoned by a single division, Napoleon was enabled to bring into line, at the battle of Wagram, a very large force, which would otherwise have had to be used to keep the Archduke John from joining his brother, during the battle, with his entire corps.

At the battle of Shiloh, Hazen's brigade lost some four hundred men, and about the same number at the battle of Stone River. But afterwards, the same brigade, assaulted by the Confederates at Chickamauga for three hours with greater fury than on either of the two previous occasions, being covered by a breastwork, completely repulsed the enemy with the loss of only thirteen men.

Military history is full of similar instances. Delaying the enemy for a few days is often all that is required to insure the success of an important operation; and a single brigade, or regiment even, holding a defile, a bridge, a town or village, or other favorable position, properly intrenched, will sometimes suffice for this purpose.

So, by intrenching the depots an army is obliged to leave behind it, and which may thereby be defended by comparatively a few men, a large force may be set free for operations in the field. In Sherman's Atlanta cam-

paign, in 1864, he had occupied and intrenched Allatoona Pass, for the purpose of holding it as a secondary base. Not only were a million and a half of rations stored there, but it was an essential link in Sherman's communications, and its capture would have greatly endangered the success of his campaign. It was attacked by a Confederate division of six thousand men, and defended by General Corse, with only nineteen hundred. The assailants were repulsed with great slaughter. Thus, by means of earth-work defences, nineteen hundred men were enabled to do the work of at least ten thousand, and more than eight thousand men were thereby added to Sherman's force in the field.

So, by means of a double *tête-de-pont*, or intrenchment at each end of a bridge, garrisoned by a small detachment, an army may be enabled to safely manœuvre on either side of a river, at its option; which sometimes gives a decisive strategic advantage.

Thus, in a campaign, a few field-works may be equivalent in effect to a large reinforcement of troops.

II.—Materials used for the Parapet.

1. Field-work parapets are usually made of *earth*.

Clay being much more tenacious than common earth, it is less penetrable to the assailants' missiles; but, for the same reason, a parapet of this material requires more labor and time for its construction.

2. Other materials are occasionally used; as bags of cotton, or of wool, wooden logs, and sand.

Bales of cotton make a good parapet; but, from their extreme liability to be set on fire by the enemy's shells, unless this can be guarded against by keeping them constantly wetted with water, bags of wool, which are less combustible, are generally preferable to them.

In our late war, cotton bales have been repeatedly used as a parapet to great advantage; as at Pine Bluffs, Arkansas, where a cavalry force of only six hundred, under Colonel Clayton, was attacked, in October, 1863, by twenty-five hundred Confederates, with twelve guns. Cotton bales, rolled out from the warehouses at thirty minutes' notice, appear to have constituted the principal defence. After an attack of five hours, the Confederates were driven away with heavy loss.

3. A parapet of *wooden logs* constitutes a sufficient shelter against musketry fire; but, when liable to be attacked by artillery, such a parapet has been heretofore considered as very objectionable on account of the fatal effects to be apprehended from the splinters. Yet, in our late war, we have witnessed the adoption of this material to an extent heretofore unparalleled. On every field breastworks were hastily extemporized, made of logs, or rails, piled up to the height of from ten to fifteen feet, with earth heaped up against them on the inside.

This was owing to three causes:

The material itself being everywhere at hand in great abundance in the densely-wooded districts through which the contending armies were operating;

The nature of the country, so full of mountain defiles and extensive forests, often rendering it necessary for the troops to secure themselves against surprise by intrenching every position they took up, like the ancient Roman armies;

The extraordinary alacrity and zeal with which our people undertake all kinds of mechanical labor, especially those requiring contrivance and skill.

4. A parapet of *loose sand* is obviously liable to be levelled by the wind and rain. When sand has been used, therefore, until the late war, it has been generally in bags. A sand-bag parapet is very rapidly constructed, and so, is preferable to an earthen one when speedy cover is required.

In regard to a parapet of loose sand, it had been moreover generally supposed that, apart from the effects of the weather, it must soon be destroyed by the enemy's shot or shell; so that, under bombardment, it would have to be continually undergoing repair. But, in our bombardment of the Confederate Fort Wagner, it was found impossible to demolish its parapet, though consisting entirely of sand; for the sand thrown up by our projectiles simply fell down again in the same place; unlike masonry, or even compact earth, which would

have been displaced, thus causing a breach. From this peculiarity in the behavior of sand under bombardment, as demonstrated at Fort Wagner, it seems probable that this material, in those places where it can be had, will hereafter be generally used for the parapets and bomb-proof shelters of field-works; and even supersede, to some extent, the use of masonry in permanent fortification; for Fort Sumter's walls were destroyed by our batteries at the distance of four thousand yards; and 110,643 pounds of metal effected a breach in the brick masonry of Fort Pulaski, causing its surrender; while 122,230 pounds of metal failed to breach the bomb-proof of Fort Wagner, which was constructed entirely of sand.

Thus sand-mound parapets are not breachable, like masonry. Though, by bombardment, a few cartloads of sand should even be displaced, they can soon be shovelled in again under cover of night, when the assailants' fire is suspended. But as their slopes, especially when not protected by a revetment or covering, can never be steep, they will oppose but slight obstruction to an assault.

As the resistance of compact quartz sand to the penetration of projectiles is known to be much greater than that of common earth, it is surprising that its fitness as a material for parapets should not have been thoroughly tested before the attack on Fort Wagner.

III.—The Profile.

1. The efficiency of an intrenchment as a defence depends chiefly on the dimensions of the parapet and of the ditch as traced on a vertical plane passing through them both. The outline thus traced is called the *profile*. (FIG. 1, FRONTISPIECE.)

2. The chief uses of a parapet are—

To cover the assailed from the assailants' fire; and

To constitute an obstacle that will not be easily surmounted in an assault.

To answer fully both these ends, the *height* of the parapet above the ground on which it stands should not be less than eight feet; which may, therefore, be considered its minimum height.

As to its maximum height:

A man cannot well throw up dirt higher than six feet; and two parties of men, the one six feet above the other, cannot, therefore, well throw up a parapet higher than twelve feet. For this reason, twelve feet is regarded as the maximum height of the parapet of a field-work; the construction of which does not usually admit of much time or labor.

3. But if the site of the work be *on higher ground* than that occupied by the assailants, the height of the parapet need not be so great. If, on the other hand, it be on lower ground, in order to furnish the same cover from

the assailants' missiles, its height must be greater; as is shown by the diagram. (FIG. 2.)

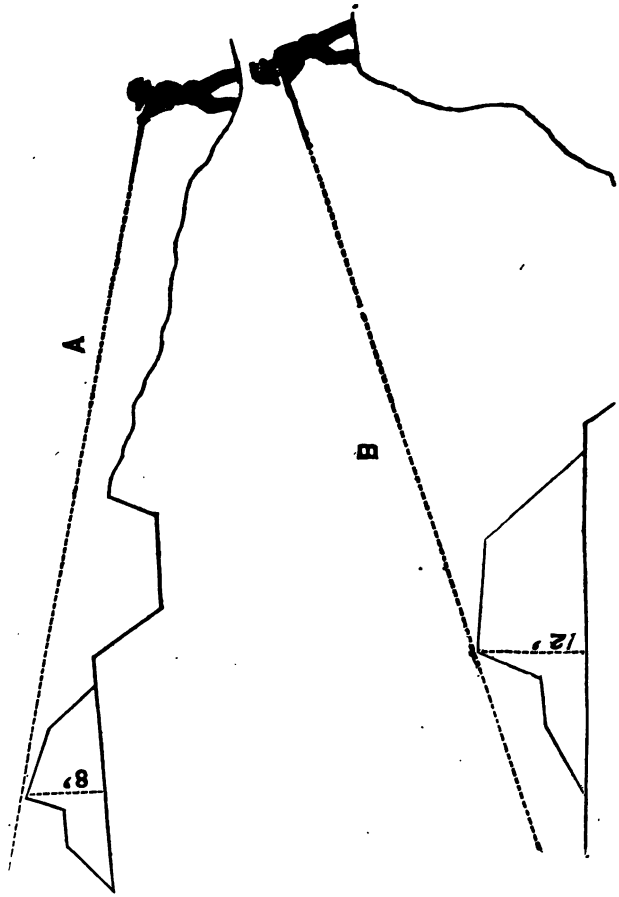


Figure 2.

At A, where the assailants fire from ground lower than the site of the work, it is obvious that an eight-foot

parapet affords more complete shelter than the twelve-foot parapet at B, where the assailants are on ground higher than the site of the work.

4. The *thickness* of the parapet should be one half greater than the penetration of the heaviest projectiles that can be used against it. If shelter against musketry only be required, it need not be over four feet thick. Against artillery fire, it should be as follows:

Against 6-pounders	9 feet.
Against 12-pounders	12 "
Against 18-pounders	18 "
Against 24-pounders or heavier guns	from 20 to 24 feet.

But as guns of a calibre over 12-pounders are rarely used in the field, twelve feet may be regarded as the usual maximum thickness of the parapet of a field-work.

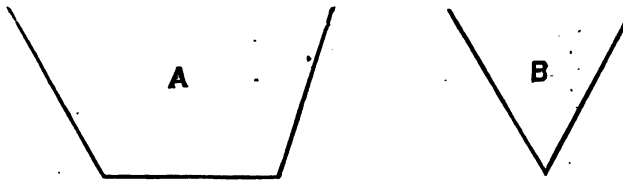
The above figures refer to smooth-bore guns. Against rifled projectiles, whose penetration is somewhat (apparently, *never exceeding one fourth*) greater, a parapet, to afford sure protection, should have a thickness of at least twelve feet of well-rammed earth; or, of freshly-dug earth, perhaps even twenty feet.

Owing to the pointed form of rifled projectiles, on coming in contact with wooden logs or with fascines, they are more or less deflected by them, and thus made to glance off in another direction. This deflection, it is found, will be caused by even a gentle sand-slope. Therefore, when the parapet partly consists of logs of

wood, or of fascines, or, probably, even of sand-bags, the thicknesses above indicated as against smooth bores will usually suffice against rifled guns also.

5. The *ditch*, to constitute any very serious obstacle, should be at least six feet deep, and over twelve feet wide across the top. As its sides slope inward, the outline of a vertical section of the ditch is a trapezoid; as at A (FIG. 3).

Figure 3.



But where the ditch has no flanking fire to protect it, it would be better that its sides should slope down to a point; so as not to give the assailants any level ground at the bottom to form on. Its outline would then be triangular, instead of trapezoidal; as at B.

6. To prevent the earth of the parapet from crumbling into the ditch, and thus filling it up, the foot of its outer slope is made to rest at a little distance from the edge of the ditch. The margin of ground left between the parapet and the ditch is called the *berm*. (FIG. 1, G H.)

7. We have already seen that the interior height of the parapet should be at least eight feet. But this

height is too great to allow the assailed to fire over it. The difficulty is obviated by raising a small platform of earth against the inside of the parapet, about four feet three inches below the top, and four feet in width; standing on which, infantry soldiers of the smallest size, drawn up in two ranks, will be able to fire over it.

This bench of earth is called the *banquette* (B C D).

In order to enable the defenders to mount more readily on the top of the parapet in repelling an assault, it has been proposed to raise the banquette to within two feet nine inches of the top; which would give, at the same time, a kneeling fire; this height to be broken by a step, which would also furnish a rest for the elbow in the fire.

8. The upper surface of the parapet is called the *superior slope* (E F). It is on this the infantry soldier rests his piece in firing over the parapet.

9. The superior slope is but slightly inclined, in order not to diminish the thickness of the parapet near the top, and thereby detract from its utility as a cover from fire. But this slightness of inclination is attended with the disadvantage of leaving a certain portion of the ground in front of the ditch uncovered by the defenders' fire; for, as will be seen on inspecting the diagram (FIG. 1), an assailant, in approaching the work, after passing the point A, would be no longer under fire from the parapet. To remedy this, a sloping embankment

(A M N) is sometimes thrown up in front of the ditch, having its upper surface in the prolongation of the superior slope of the parapet; by which means the assailants are kept under fire till they arrive at the ditch.

This embankment is called a *glacis*.

The glacis has another advantage, besides the one already mentioned; that of screening the scarp (or inner wall of the ditch) from the enemy's artillery fire.

10. A margin of ground is left between the glacis and the outer edge of the ditch, in the same manner as between the parapet and its inner edge, and for a similar reason. This margin is called the *covered way* (L N). Where the glacis is high enough to give cover against the assailants' fire, troops, especially sharpshooters, may often be stationed with advantage in the covered way.

11. The *other slopes* are as follows:

The slope of the banquette, by which the men ascend to fire over the parapet (B C);

The interior slope of the parapet, against which the soldier leans when he delivers his fire (D E);

The exterior slope of the parapet (F G);

The slope of the glacis (M A).

12. The side or wall of the ditch next to the parapet is called the *scarp* (H I); the side or wall opposite, the *counterscarp* (K L).

13. A *crest* is the line terminating the upper side of a slope along its entire length (FIG. 4, A B);

As, the crest of the scarp; of the counterscarp; of the exterior slope of the parapet; of the interior slope of the parapet; which last is commonly called the *interior crest.*

14. The line running along the bottom or lower side of a slope is called its *foot* (FIG. 4, C D); as, the foot of the banquette slope; of the interior slope; of the exterior slope; of the scarp; of the counterscarp; of the glacis.

15. The *most convenient inclinations* of the respective slopes have been shown by experience to be as follows:

The banquette slope, two base to one perpendicular.

The *tread* of the banquette (that is, its upper surface, on which the soldier stands) (Fig. 1, C D), receives a slight pitch to the rear, in order to shed water.

The interior slope of the parapet, one base to three perpendicular.

The superior slope of the parapet, a base of from four to six times its height.

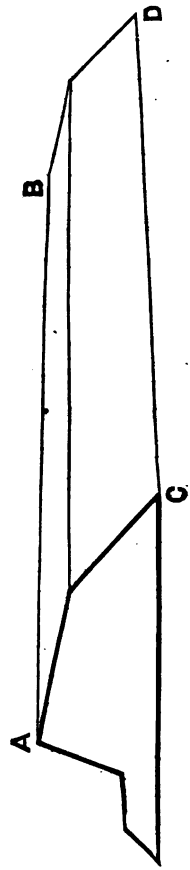


Figure 4.

The exterior slope of the parapet, one base to one perpendicular; in other words, an angle of forty-five degrees.

This being the inclination which loose earth naturally assumes on being thrown up, it is called the *natural* slope.

When sand, instead of earth, is the material used, it is obvious that all these slopes must be very considerably diminished, to give the requisite solidity.

The scarp cannot be made as steep as would be desirable, as it has to bear the weight of the parapet. The base of its slope is equal to two thirds of the depth of the ditch.

The counterscarp may be steeper than the scarp, not having the weight of the parapet to support, and not being exposed to the enemy's artillery fire. Accordingly, the base of its slope is one half of that of the scarp.

The slope of the glacis is the same as that of the superior slope of the parapet, it being in prolongation of it.

16. The *width of the berm*, in firm soil, is from one and a half to two feet. In marshy or in sandy ground, it may have to be as much as six feet.

The berm furnishes ground for the workmen to stand on in throwing up the parapet; and also serves to keep the parapet from crumbling into the ditch. Its defect is that in the assault, it enables the assailants to climb on the parapet; but it may usually be cut away after the parapet has had a few days to settle.

17. The *command* of a work is the height of its interior crest above the ground on which it is erected.

18. The *relief* of a work is the height of its interior crest above the bottom of the ditch.

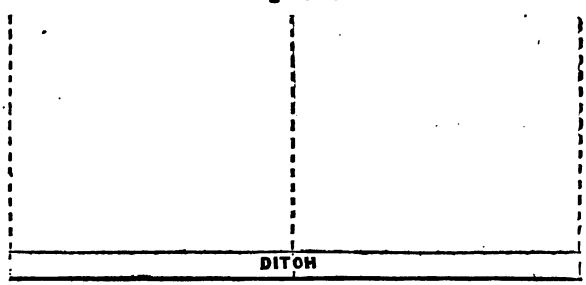
19. The greater the relief of a work, *the stronger its profile* is said to be. It is evident that, the stronger the profile, the more serious are the obstacles to be encountered by the assailants, the longer are they kept under a deadly musketry fire from the parapet, and the heavier must be their loss. Consequently, the stronger the profile of a work, the larger is the force required to carry it.

IV.—Of the Plan.

1. The *plan* or *tracé* of an intrenchment is the form of its horizontal outline.

2. The simplest form is that of a *Right Line* (FIG. 5).

Figure 5.



(*N. B.*—In this diagram, and in those which follow, three broken lines are used to indicate the direction of the fire from the face or flank of a work.)

A Right Line has three defects:

(1.) It is open to assault on both flanks;

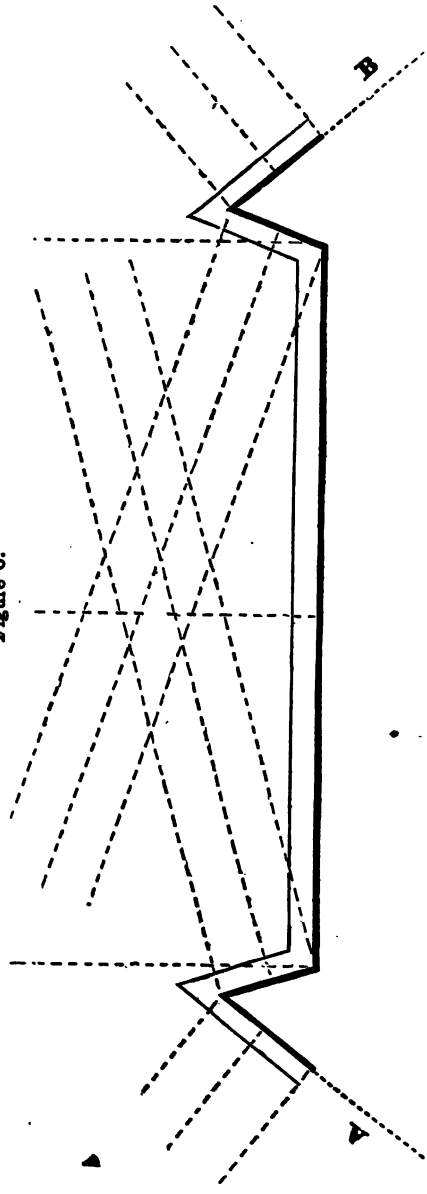


Figure 6.

(2.) It has no cross fire in front;

(3.) From the moment the assailants descend into the ditch, they are safe from fire, there being no flanking arrangement to rake the ditch.

3. A Right Line *flanked with a fléche* at each extremity is, therefore, preferable. (Fig. 6.)

Filled with sharpshooters, these fléches—

(1.) Would give a cross musketry fire in front of the work;

(2.) Could be so used as to rake the ditch in its whole length;

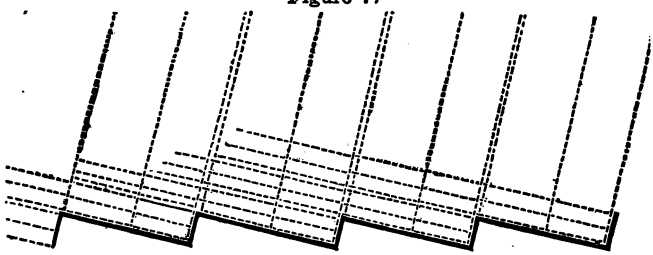
(3.) To a certain extent, would protect the flanks of the work, by com-

pelling the assailants to make a large circuit to turn them;

Finally, by prolonging their outer faces to the rear, as at A and B, the defenders would be protected from enfilade.

4. An *Indented Line*, or *Crémaillière* (FIG. 7), is preferable to a Right Line;

Figure 7.



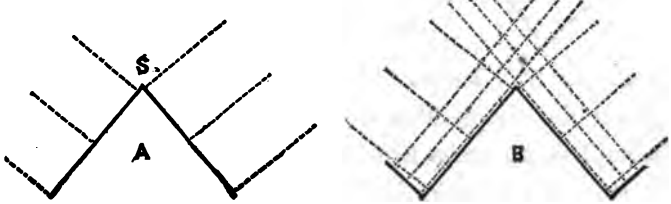
For it gives—

(1.) A cross fire in front of the work;

(2.) A raking fire along the whole ditch. For this purpose, the short faces, as will be seen on inspection, should form with the long ones a right angle, or at least an angle but slightly obtuse.

5. A *Redan* is formed by two right lines meeting at an angle, like two sides of a triangle; that is, it is a triangle with one side left out. (FIG. 8.)

Figure 8.



The Redan, being partly enclosed, affords more protection to the assailed than a Right Line.

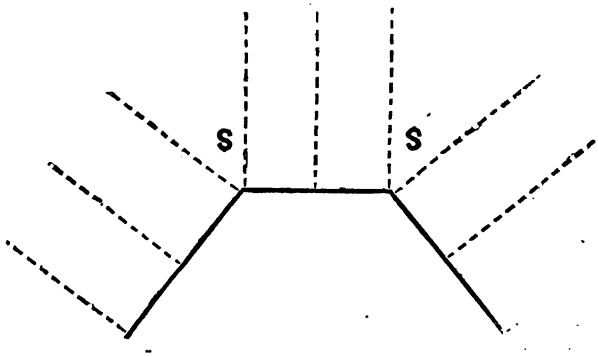
The opening in rear is called the *gorge*.

The defect of an open gorge may sometimes be remedied by terminating the faces of the Redan on a river, a marsh, or other natural obstacle.

A Redan has no flanking arrangement to protect the ditch. To supply this defect, *crotchets* may be added, perpendicular to the faces, as at B.

Another of its defects is the large space in front of its salient angle uncovered by the defenders' fire (called a sector without fire), as at S. To remedy this, the work is sometimes made to terminate in front by a straight line, instead of a point; this termination being called a *Pan Coupé*. (FIG. 9.)

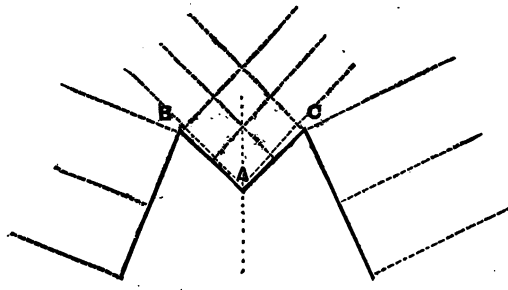
Figure 9.



But this still leaves two small sectors without fire (S, S); and the simple Pan Coupé, like the simple pointed Redan, has no cross fire in front, nor any flanking arrangement to rake the ditch.

6. If, for the straight line forming the pan coupé of a redan, we substitute a re-entering right angle with its vertex on the capital (or line bisecting the salient angle), we have a *Priest Cap*, or *Mitre*, which it exactly resembles. (FIG. 10.)

Figure 10.



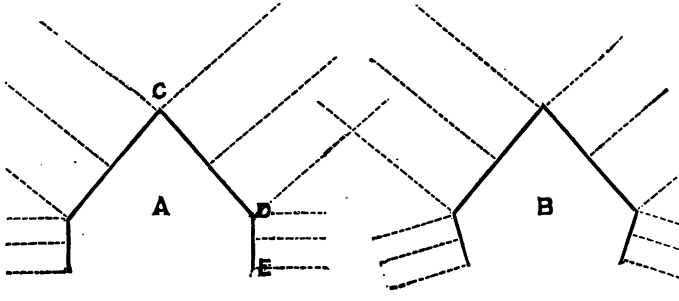
A Priest Cap has two advantages over a Pan Coupé:

(1.) It virtually does away with the sectors without fire;

(2.) By the cross fire it affords, it renders an assault in front very dangerous.

7. A *Lunette* is a redan prolonged in rear by two lines parallel to the capital. (A, FIG. 11.)

Figure 11.



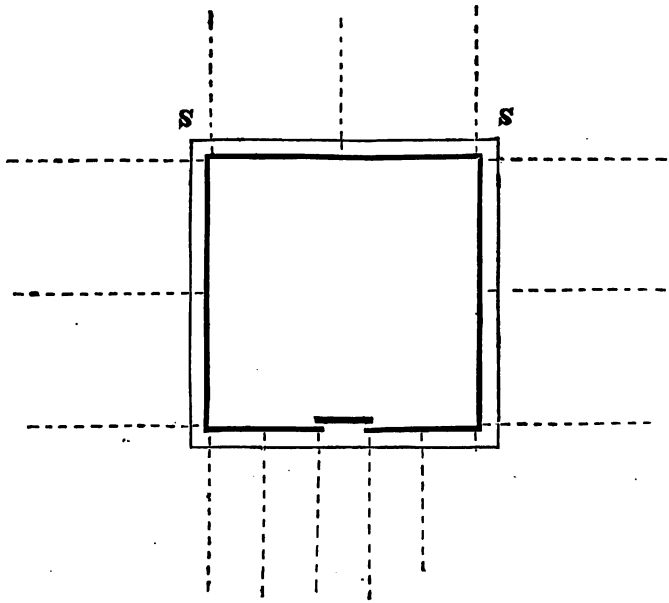
These rear lines sometimes incline toward the capital, as at B.

Its only advantage over a Redan is that it affords more protection to the flanks and rear.

The Redan, the Priest's Cap, and the Lunette, have all one defect which does not exist, to any extent, in other works; that of offering long faces running more or less toward the enemy, to be enfiladed by his batteries.

8. A *Redoubt* is any work enclosed on all sides. (FIG. 12.)

Figure 12.



Its advantage over the works already mentioned is that, not being open at the gorge, it cannot be entered in rear.

The Redoubt has two defects:

First, It leaves a large sector without fire at every salient angle, as at S, S.

This defect may be partially remedied by breaking each salient angle into two or more smaller ones, as at A (FIG. 13).

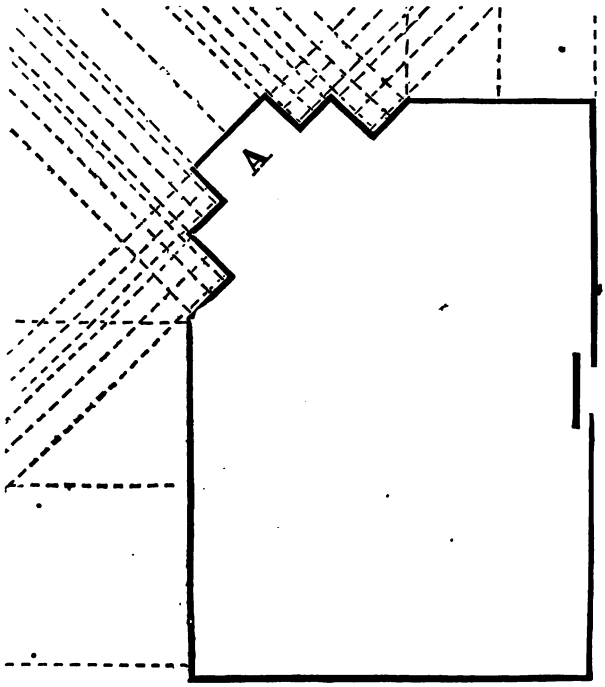


Figure 13.

Secondly, It has no flanking fire to sweep the ditche This defect may be remedied in two ways:

(1.) By *loopholed galleries* behind the counterscarp a the salients of the ditch; placed in which, a few mei may sweep the entire ditch with a musketry fire (FIG. 14.)

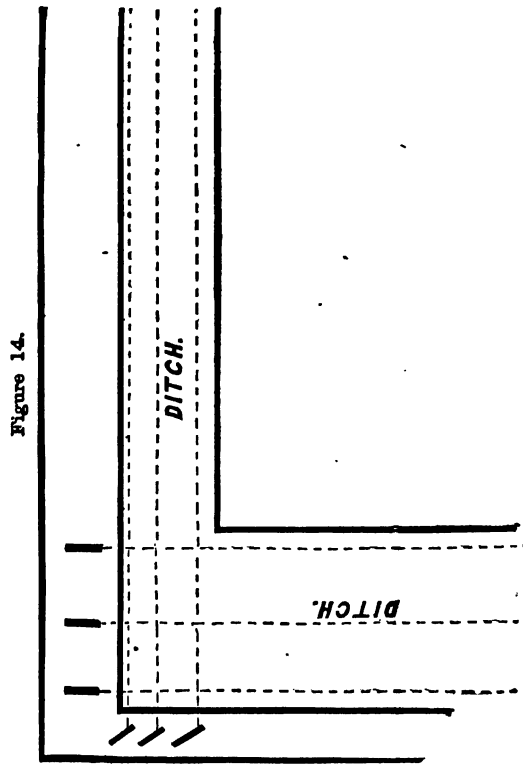


Figure 14.

(2.) By *caponnières;* which are galleries directly across the ditch, constructed of palisades or pickets, and roofed over with plank and earth, to cover the men stationed in them from shells, and from a plunging fire from the crest of the counterscarp. By means of loopholes pierced in each of their sides, the entire ditch may be swept by a musketry fire.

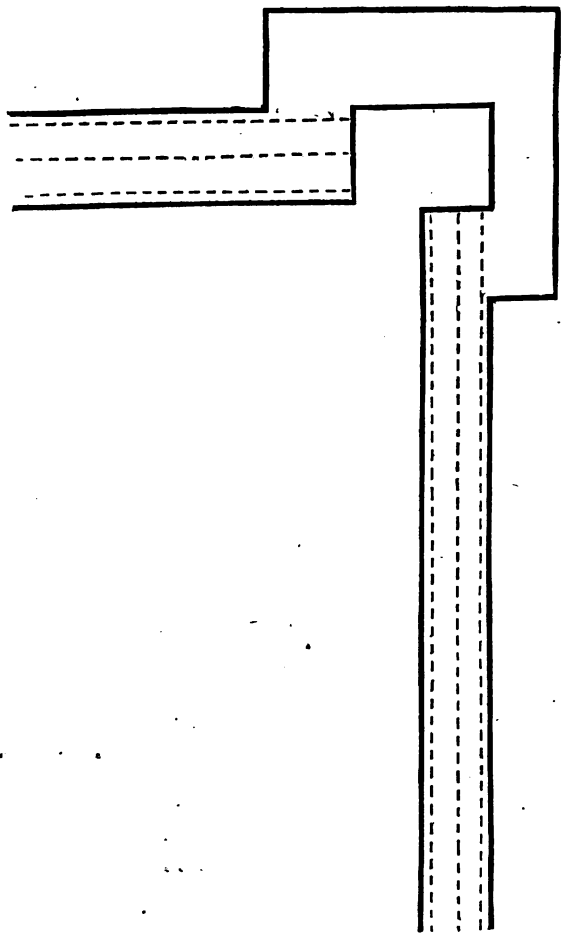
To prevent the caponnière from being used by the assailants as a bridge, the ditch between it and the counterscarp is widened.

To cover the caponnière from the enemy's artillery, it should be hidden by the counterscarp crest, or by a glacis.

It should be provided with a wicket gate on each side, to allow of sorties from it into the ditch.

The best place for a caponnière is at a salient or advanced angle of the work; for, thus placed, one caponnière will suffice to flank two ditches in their whole length. (Fig. 15.)

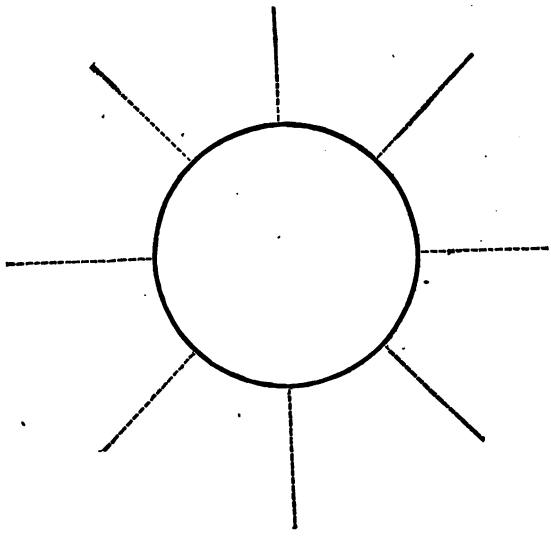
Figure 15.



To give a passage in and out of the gorge of a redoubt, an opening must be left in the parapet. In front of this opening, a bridge over the ditch is used, made of beams and loose plank; which may be taken up in a moment, and converted into a barricade. If the ditch be over twelve feet wide, the bridge will need trestles under it, to support it.

9. Of all the figures for a redoubt, a *circular* one is the worst. (FIG. 16.)

Figure 16.

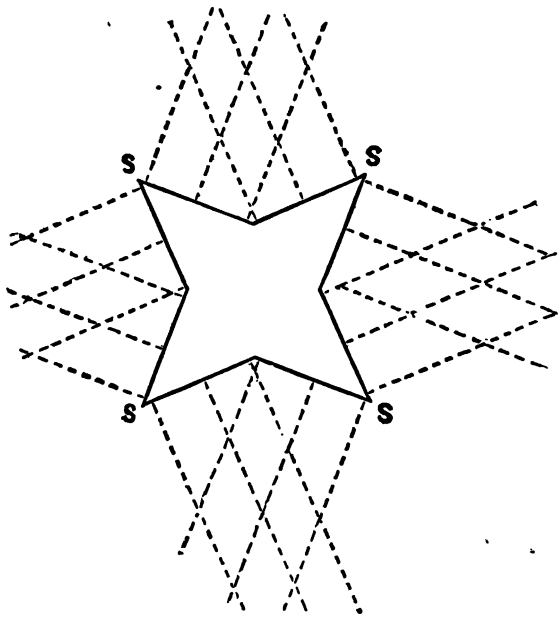


For, First, it has not only no flanking arrangement to protect the ditch, but is not susceptible of receiving one; and

Secondly, Only certain portions of the ground around the work are covered by its fire; and on whatever point the enemy may choose to advance, but a very few guns can be brought to bear upon him.

10. The *Star Fort* is a redoubt now seldom used. (Fig. 17.)

Figure 17.

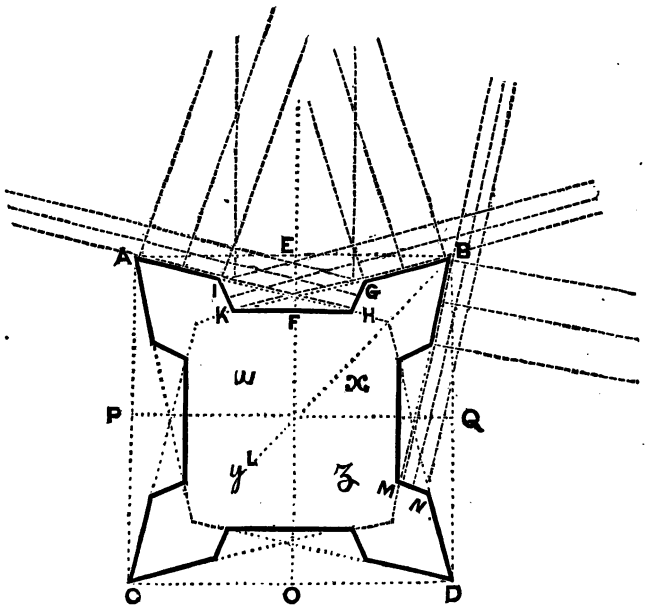


It gives a cross fire in front of each face; which is its only advantage over a square redoubt. On the other hand, it enlarges the sectors without fire (s, s, s, s); and, by adding to the length of the interior crest, it increases

the labor of erection, and the number of men required to defend it.

11. The *Bastion Fort* is a redoubt so constructed as to leave no sector without fire, and to sweep every part of the ditch by a flank fire. (FIG. 18.)

Figure 18.



This is the most perfect form of intrenchment that exists; it being the only one in which every portion of the ground around it, and of the ditch, is swept by a fire from the work. It offers on every side a most formidable resistance to an assault; for all the ground around

it is covered by cross fires. In front of each salient (B) are two cross fires (from I K and M N); in front of each face (G B) are two cross fires (from G B and I K); and in front of each curtain (K H) there are three cross fires (from K H, I K, and G H).

But this kind of redoubt requires so much time and labor for its construction, that it is used only when a defence of the nature of a permanent work is needed for an entire campaign.

12. The *rules for planning a Bastion Fort*, to be used as a field-work, are as follows:

(1.) Lay out a square, as A B C D (FIG. 18); or a pentagon.

(2.) Bisect the sides by perpendiculars, E O, P Q.

(3.) On these perpendiculars, set off from the sides one eighth (or in case of a pentagon, one seventh) of a side, as E F.

(4.) Through the points set off, draw lines from the salients of the polygon; as A H and B K. These are the *lines of defence*.

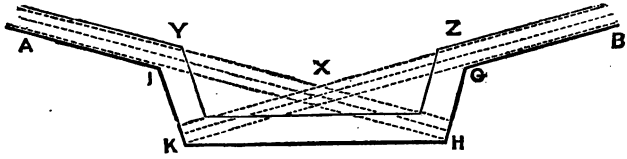
(5.) On these lines of defence, set off from the polygon salients, distances equal to two sevenths of a side, giving the *faces*, as A I and B G.

(6.) From the inner extremities of the faces, draw lines perpendicular to the lines of defence, as I K and G H. These are the *flanks*.

(7.) Connect the inner extremities of the flanks by straight lines, which are called *curtains*, as K H.

13. On examining the plan of a bastion front (FIG. 19), it will be seen, that, without some modification, the

Figure 19.



ditch along the face A I, cannot be swept by the fire from the flank, H G, because the view of that ditch from this flank is intercepted by ground in front of the curtain; and that the same difficulty exists with respect to the fire from the flank I K, along the ditch G B.

The most effectual mode of obviating this difficulty is by *removing the earth in front of the curtain*, as far out as the point X; that is, by extending the ditch forward along the whole front as far out as the line Y X Z.

14. A *Réduit*, or *Safety Redoubt*, is an inner work which serves as a place of retreat, or citadel, on the defenders being driven from the main work. It may follow the plan of the exterior work, or it may be a simple redoubt, or a blockhouse, or a tower of brick or stone.

It should have a fire into all the salients of the main work, so as to make them untenable by the enemy; and it should have a command of at least five feet over the interior crest of the outer work, so that the enemy may not be able to fire into it from the parapet.

The réduit may serve at the same time as barracks for the troops.

15. The following are the principal terms used in reference to the plan of a work (some of them have been already mentioned):

(1.) The *terre-parade plein*, or simply the *terre-plein*, is the ground in the interior of the work on which the troops assemble; marked *w x y z*, on the plan of the Bastion Fort, FIG. 18.

(2.) A *salient* is a portion of a work situated at an angle pointing outward.

The angle at the point is a *salient angle*, as at A or B.

(3.) A *re-entrant* is a portion of a work situated at an angle pointing inward; and the angle is a *re-entering angle*, as at K or H.

(4.) A *capital* is a line bisecting a salient angle, as B L.

(5.) A *face* is any side of a work giving a direct fire on the assailants during their entire approach, as A I or G B.

Faces are *advanced* or *retired*. In the lunette (FIG. 11), C D, is an advanced face, D E, a retired face.

(6.) A *flank* is a side of a work protecting a face by a fire sweeping in front of it, as I K or G H.

A *flanked disposition* is any one that effects this object; as in a Right Line (FIG. 6), the flèches at its extremities.

(7.) A *curtain* is a line connecting two flanks, as K H.

(8.) In a bastion, the angle I, formed by a face and a flank, is called the *shoulder angle;* and the angle K, formed by a flank and a curtain, is the *angle of the curtain.*

(9.) An *angle of defence* is the angle formed by a flank and the prolongation of the opposite face, as the angles A H G and B K I.

This angle should always be a right angle, in order that the flanking fire may be direct; a direct fire being more effective and reliable than an oblique one; because, first, the soldier, when in action, being most occupied with what is directly in front of him, often fails to perceive an enemy to his right or left; and secondly, an oblique musketry fire is not generally accurate; perhaps because delivered in a position which is not the soldier's habitual one.

(10.) A *line of defence* is the distance of a salient from the opposite flank, as A H or B K.

(11.) The assailants once in the ditch at a re-entering angle of the work, are out of fire; as at A, in the priest cap (FIG. 10). It is true that the ditch along A B, is swept by the fire from the face A C; as is also the ditch along A C, by the fire from the face A B. But the soldiers stationed near the point A, cannot look down over the parapet and see that portion of the ditch immediately below them; that is, the portion situated at the re-entering angle. This portion of the ditch, therefore, is not under fire, and the re-entering angle is called a *dead angle.*

But a re-entrant of the ditch which is exposed to fire from any other part of the work is not a dead angle. Thus, the Bastion Fort has no dead angle; as the spaces in the ditch at the re-entrants may each be swept by the fire from an opposite flank. (FIG. 20.)

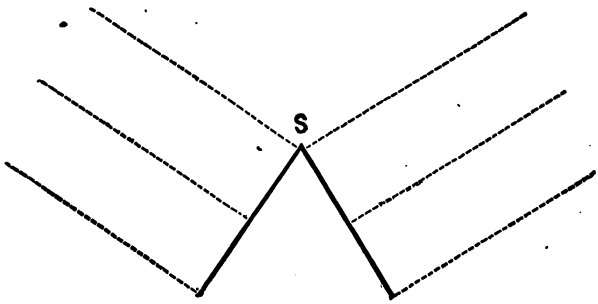
Figure 20.

Thus, the portion of the ditch at the re-entering angle K, is reached by the fire, slightly changed in direction, from the men near H; and the portion at the re-entering angle H, is reached by a similar fire from the men near K.

The same remark is applicable to a Right Line flanked by fléches.

(12.) A *sector without fire* is the ground in front of a salient not covered by a fire from the work, as at S (FIG. 21).

Figure 21.



The Bastion Fort has no sector without fire; the ground in front of the salients, as at B (FIG. 18), being swept by a cross fire from the opposite flanks, I K and M N.

16. The most important requisites of a good plan are as follows:

(1.) A *flanked disposition*, to sweep every part of the ditch.

For if the assailants can find shelter in the ditch, it will enable them to either mine the scarp, and thus destroy the parapet; or rally and form in safety, and then mount the parapet together in large force.

(2.) The *line of defence should not exceed in length the accurate range of musketry*, in order that this fire may sweep the entire ditch and reach the enemy in front of the salients. This distance has been, heretofore, fixed at one hundred and sixty yards; but the greatly increased range of the new firearms will enable it to be lengthened very considerably.

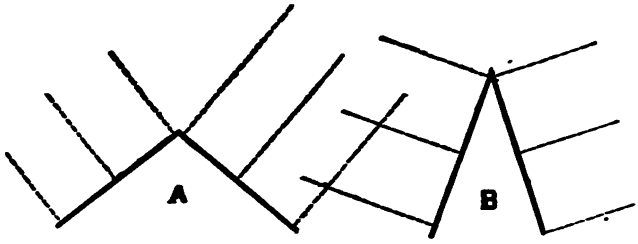
(3.) A salient angle should *never be less than sixty degrees*—

To prevent the salient from being worn away by the weather;

To afford room for the movement of troops within it; and

To diminish the sector without fire.

Figure 22.



(FIG. 22.) It is manifest that the sector without fire of the redan A is less than that of the redan B; in other words, that the more obtuse the salient angle, the less is the sector without fire.

(4.) In order to prevent the enfilading of the faces, which would make them untenable, they should be directed, so far as possible *toward points inaccessible to the enemy.*

Finally, the more completely the ground around is *covered by cross-fires*, the more formidable is the work. Apart from their multiplied destructive effect, the parts assaulted, by their means, are protected by the fire of those that are not, as well as by their own.

17. The various plans of intrenchment have now been explained, together with their respective advantages and defects. In the choice of a plan for any particular locality, these advantages and defects should be carefully weighed, and the ground studied in reference to them.

But it must be remembered that these plans are not to

be taken as models to be copied, but *merely as types*, to be varied from according to the nature of the ground, and the exigencies which the intrenchment is intended to answer. The faces of a work need not therefore be of the same length; and the actual *tracé* may be in other respects wanting in symmetry. The most important requisite is that the greatest amount of fire possible may be concentrated upon those points which will afford the enemy the greatest facilities for attack.

V.—Of Bridge Heads.

1. An intrenchment to defend a bridge is placed in front of it, and is called a *bridge-head*, or *tête-de-pont*.

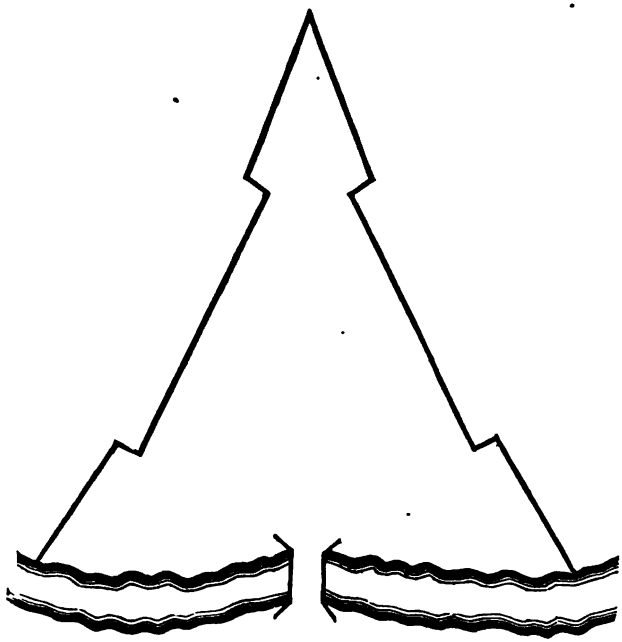
The same term is applied to a work used for the defence of a dike, a causeway, the head of a defile, or of a landing-place.

If the object be to secure a *débouché* on both sides of a river, there must be a bridge-head at each end of the bridge.

2. The *simplest form* of bridge-head is a redan, with a crotchet on each flank to sweep the faces. But this defence is not formidable enough when it is very important that the bridge should be held. In that case, a simple crown, or a complex crown should be used.

3. A *Simple Crown* consists of a bastion in the centre, with a half bastion on each flank. (FIG. 23.)

Figure 23.



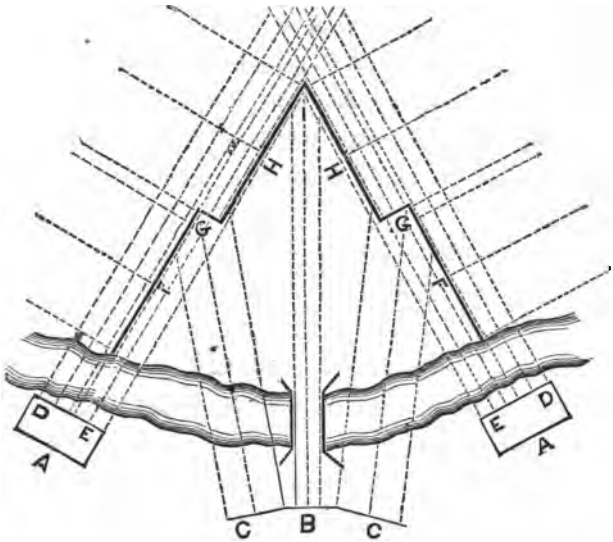
4. A *Complex Crown* is a polygon of three or more sides; each side being a bastion front.

5. *One of the best* of the simple forms of bridge-head is a redan, with a crotchet thrown out on each flank, for musketry, and connected by a face with the river bank. (FIG. 24.)

6. The essential *auxiliary defences* of a bridge-head are—

(1.) Works, open or enclosed, on the opposite side of the river, to flank the faces, and also to sweep the ground

Figure 24.



in front of the advanced salient, by a cross artillery fire; as A, A, in the above diagram.

(2.) A work (B) in rear of the bridge, to rake it with its fire, if the enemy should carry the bridge-head, and attempt to cross.

7. An inspection of the above diagram will show—

(1.) That the ground *in front of the advanced salient* I is swept by a cross-fire from the crotchets G, G, and the outer portions, D, D, of the front faces of the works, A, A.

(2.) That the faces H, H, of the redan have also *a cross-*

fire in front of them, consisting of their own direct fire, and of the flanking fires from G, G, and D, D.

(3.) That the *ditches* of these advanced faces are swept by a flanking musketry fire from the crotchets G, G.

(4.) That the fire from the faces F, F, is *crossed by a flank fire* from the half faces D, D, which also protects their ditches.

(5.) That if the enemy should nevertheless succeed in penetrating into the bridge-head, he would find it *made untenable* by the cross-fires from the work B, and its two crotchets C, C, and from the inner half faces E, E, of the works A, A; leaving him no sheltered space on which to rally and form.

(6.) Finally, that the enemy, in *crossing the bridge*, would encounter a raking fire from the work B.

8. Where a landing in the enemy's country requires to be permanently guarded by a considerable force; as, for instance, a *base of supplies* for an army operating in the field; there should be an outer line of works at five hundred yards, or effective grape-shot distance, from the bridge-head. (FIG. 25.)

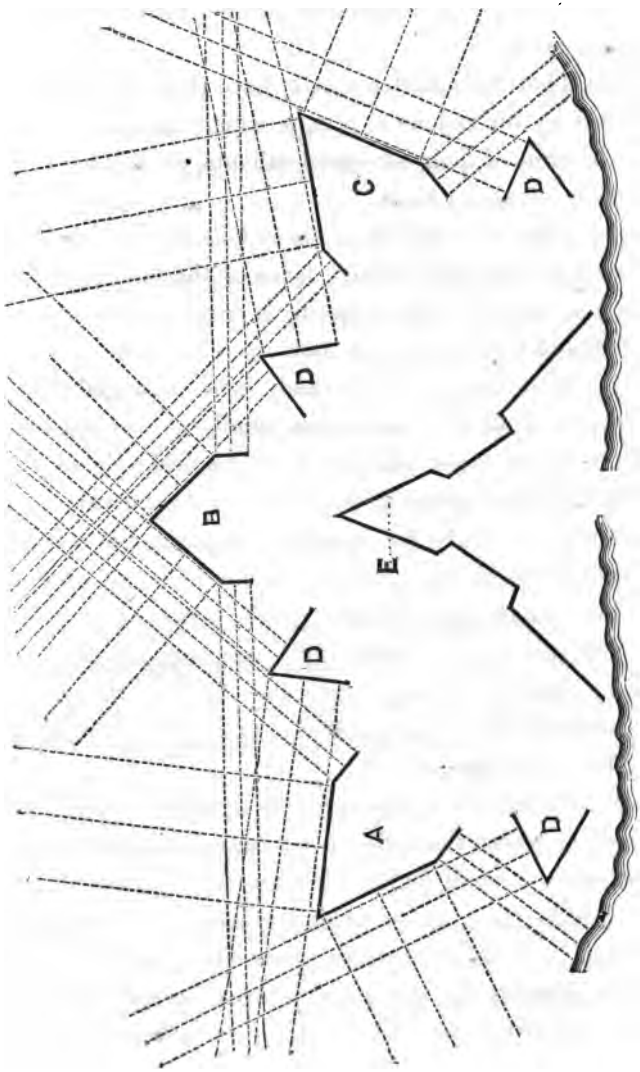


Figure 25.

9. On a careful inspection of the above diagram, it will be seen—

(1.) That the lunettes A, B, C, have their *advanced faces flanked* by the redans D, D, D, D, which also give a cross-fire in front of their advanced salients, as well as in front of their advanced faces.

(2.) That the *salients of the redans are protected* by a cross-fire from the retired faces of the lunettes; which fire also adds to the cross-fire in front of the advanced salients of the lunettes on their right and left.

(3.) That the works can easily be so arranged that the interiors of all the outer ones shall be reached by the fire from the faces and flanks of the bridge-head; thus *rendering them untenable*, if carried by the enemy.

(4.) That though the lunette B, opposite the advanced salient of the bridge-head, may seem to be an exception to this remark, the difficulty can be obviated *by terminating the salient of the bastion by a pan coupé*, as at E.

(5.) That the arrangements indicated in the diagram are susceptible of being *added to* or *varied from*, according to circumstances.

10. A common bridge-head is suitable only for small rivers, or where the defile to be passed in rear is a short one, or for a small force which can readily pass it. But for a wide river, or one which *a large force*, fighting in retreat, is obliged to cross, room must be left in front of the crossing for the army to draw up and defend itself. In such a case, an arrangement somewhat similar

to the one last described would obviously be the most suitable one; but the positions of the outer works would have to be determined by the exigencies of the ground, as an intended field of battle.

11. A bridge-head may be used not only defensively, but also to *cover an offensive operation.*

To fight the battle of Marengo, the Austrian army, forty thousand strong, which was posted at Alessandria, on the left bank of the Bormida, had to cross the river by two bridges only, in face of the French army. It would have been manifestly impossible for such a force to debouch on the field of battle by two bridges in presence of a hostile army, but for the extensive bridge-head which the Austrians had constructed on the enemy's side, covering both their bridges.

VI.—Of the Armament.

1. The parapet, with a banquette, suffices for a defence by the fire of musketry. But for artillery, openings are made through it, called *embrasures;* or else arrangements are made to enable the guns to fire over the parapet, *en barbette,* as it is called.

2. The *heaviest* guns are placed in the faces of the work; as the fire from the faces should sweep the approaches to the greatest possible distance. The lighter guns are placed in the flanks; the fire from which, being used only to sweep the front of the opposite faces, is at short range.

3. *Several guns should be together;* for we cannot expect to repulse the enemy except by a heavy, well sustained fire.

4. *Barbette guns* are placed on a mound of earth thrown up against the interior slope, and flat at the top; with a slope, called a *ramp*, to ascend it by from the terre-plein. The top of the mound is at a greater or less distance below the top of the parapet, according to the dimensions of the gun-carriage.

5. Barbette guns have *two advantages:*

(1.) By being on higher ground, they have a greater command, and therefore, a more extensive range.

(2.) As they can be pointed in any direction, they have a wider field of fire.

Their *defect* is that the men and guns are completely exposed to the enemy's fire.

6. The most useful place for a barbette gun is at a salient; as, there, it commands the unprotected ground called the sector without fire.

To *prepare a salient* for a barbette gun, the salient is cut by a pan coupé; and the gun is so placed as to fire in the direction of the capital. If several guns are to be used there, the pan coupé is widened proportionally.

7. The *light* guns are better placed en barbette, as they can be quickly withdrawn if the enemy's guns open upon them. Howitzers are also good, so placed, as they should have a wide field of fire; shells being for-

midable both against infantry columns and cavalry, and useful in places where solid shot would produce but little effect.

8. There is one advantage attending a work having *an extensive area:* It enables us, in addition to the fixed armament, to use the powerful auxiliary of field or movable artillery; by which we may promptly reinforce or concentrate at any point, may support sorties, and, in case of an assault, meet the assailants with a deadly fire from the crest of the breach, or take their storming columns in flank.

Moreover, when a field battery is used, which multiplies itself, as it were, by its rapid movements, it is obvious that certain portions of the parapet may be safely left without any armament.

9. The different parts of an embrasure are as follows:

The *sole* is the bottom of the opening. It slopes downward toward the outside, so as to allow the gun to be fired at an inclination; and this slope should be at least one perpendicular to six base; because guns may be fired at this degree of depression without serious injury to the carriages.

The *mouth* is the interior side of the opening.

The *splay* is the widening of the embrasure towards the exterior.

The *genouillière* is the portion of the parapet under the sole.

The *cheeks* are the sides of the embrasure.

A *merlon* is the portion of a parapet between two embrasures.

Wooden platforms are often placed under the gun-carriages, to keep the ground underneath from being worn into ruts by frequent firing.

In using an embrasure, the muzzle of the gun should enter it to the depth of six inches, at least; to prevent the explosion from injuring the cheeks.

10. The *advantage* attending the use of embrasures is that the men and guns are sheltered from fire.

But embrasures have *three defects;*

(1.) They weaken the parapet;

(2.) They are natural breaches, furnishing openings for the entrance of the enemy in the assault;

(3.) The field of fire of embrasure guns is very limited.

From this last consideration, their best place is in the flanks of the work; whose office is simply to protect the faces by a direct fire.

11. *Loopholes* are narrow, rectangular, vertical openings through masonry or wood, used as embrasures for musketry. They should not be less than three feet apart, so that the defenders may not be crowded; and not less than six feet higher than the ground outside, so that the assailants may not fire through them.

This rule was disregarded in the construction of Fort Mims, in Alabama, in the Creek war of 1813. This

was a stockade work, in which the loopholes were pierced at only three and a half feet from the ground. The fort was assaulted by a thousand Indians, who used the loopholes from the outside with terrible effect. The work was captured, and the entire garrison slaughtered.

Trestles, with planks laid over them, will enable the loopholes to be used by the defendants on the inside. Or else the loopholes may be pierced at a convenient height for the defenders, and protected on the outside by a ditch deep enough to prevent their being used by the assailants.

VII.—Of Traverses and Defilation.

1. When any part of the interior of a work is exposed to the enemy's fire from some more commanding point, a mound of earth, called a *traverse*, is thrown up on the terre-plein, high enough and thick enough to shelter the exposed part from fire. This operation is called *defilading*.

The same object may sometimes be attained by adding to the height of a portion of the parapet, or by depressing the terre-plein; or by both these methods combined.

When a defilation is made by increasing the height of the parapet, the earth for this purpose should obviously be obtained by making the ditch wider and deeper at that point, rather than by transporting it from a distance.

2. A defilading traverse across the rear of a work is called a *parados.*

3. A traverse is usually placed *opposite the opening* or *passage way through the gorge* of a redoubt, to complete the shelter of the interior of the work.

4. When the face of a work is exposed to *enfilade,* it should be protected by one or more traverses. For this purpose, a traverse is sometimes placed on the flank exposed; and sometimes traverses are placed between the guns.

At the battle of the Alma, the main battery of the Russians had no traverse to protect it from enfilade; so, the moment a troop of English horse artillery galloped up and took an enfilading position on its right, it had to be abandoned.

5. Traverses made of earth and other materials, and supported by an interior framework of timber, are sometimes thrown up on the inside of a redoubt, as *places of shelter* for the garrison against the enemy's shells.

One inconvenience attending these shelters is, the danger of the defenders being shut up in them by a sudden rush of the enemy immediately on his guns ceasing to play.

Another inconvenience to which they are liable was exhibited at the siege of Sebastopol. At the final assault on the Russian works, on the French entering the Malakoff bastion, they found themselves completely covered from the fire of the interior redoubt by the

numerous traverses the Russians had erected for bomb-proof shelters.

6. When these shelters are used for the purpose of covering the guns and the men working them from the enemy's fire, they are called *casemates*. But owing to the time and labor required for their construction, casemated works are rarely used in the field.

7. An intrenchment is sometimes occupied and armed by a field battery. In that case, a traverse or *épaulement* (that is, a simple parapet or breastwork) will be required within the work, or near it, to cover the horses and material from fire; so, whenever any portion of the garrison of a work consists of cavalry, a similar precaution is requisite for the safety of their horses.

VIII.—Auxiliary Materials used.

1. These are for *additional shelter* against the enemy's fire, and for protection of the work *against the weather*. As they require extra time and labor for their preparation, as well as special knowledge and skill, they are used only when it is desired to make the work stronger and more durable than is needed for a short, temporary occupation.

2. A *revetment* is a facing given to certain portions of a work, which supports them, and, to some extent, presents an obstacle to the penetration of the enemy's missiles.

3. In field-works, the portions revetted are usually

only the *interior slope* and the *scarp*. Of the two, the interior slope is more in need of revetment than the scarp; since the parapet is made of freshly-moved earth, while the earth of the scarp remains undisturbed in the ground.

But in a work built of loose sand, all the slopes must obviously be supported by revetment, if it be desired that they shall maintain sufficient steepness to resist an assault.

4. A revetment may consist of *sods, sand-bags, pisa, plank, hurdles, fascines,* or *gabions*. Trunks of trees have been sometimes used; but they are objectionable on account of the splinters. Moreover, if laid horizontally along the scarp, or counterscarp, they serve as steps to the assailants.

5. A *sod* revetment is speedily made, and is very durable.

6. *Sand-bags* are coarse canvas-bags, three fourths full of sand or earth. Filled quite full, the bags would be apt to burst. The most convenient size for them is two feet eight inches long by one foot eight inches wide. If made larger, their weight, when filled, would be too great for easy handling and carrying by one man.

7. *Pisa* is a mixture of earth and clay, kneaded with a little water; to which may be added chopped straw.

8. A *plank* revetment is made by nailing boards over pieces of scantling. This revetment is used chiefly for the scarp.

9. A *hurdle* revetment consists of a wicker-work of twigs, interlaced between poles laid in an upright position against the interior slope, with their lower ends driven down into the banquette.

Hurdles, made three feet by two, are also useful to throw over boggy ground, or a muddy ditch, to make it passable.

10. *Fascines* are cylindrical bundles of twigs, ten feet long, and nine inches in diameter, bound together by withes or gads. These are laid horizontally in rows, one above the other, along the interior slope, parallel with its crest; and fastened to the soil by small pickets driven through them.

There is a kind of fascines, called *saucissons*, twenty feet long and twelve inches in diameter, used chiefly for the revetment of artillery batteries.

11. *Gabions* are cylindrical baskets, but without top or bottom, two feet nine inches high, and two feet in diameter, made of a wicker-work of twigs, woven round poles. They are laid against the interior slope endwise, resting on fascines embedded in the ground. They are filled with earth and surmounted with another row of fascines at the top.

12. A mound of earth encased with several rows of gabions, two or three tiers high, is a *gabionnade;* which, placed as a traverse, perpendicularly to the parapet of a work, or to the épaulement of a battery, will prevent guns being raked by an enfilading fire.

13. This traverse is sometimes also placed between guns; and being a shelter against splinters and the flying fragments of shells, is called a *splinter-proof* traverse.

At the siege of Sebastopol, the Russians used for bomb-proof shelters, gabionnades six feet high, roofed over with plank, and covered with six feet of earth as a minimum depth. None of them were broken in.

As to bomb-proof shelters, from our experience in the late war, it would seem that a casing of timbers fifteen inches in diameter, covered with eight feet of earth, would be a sufficient protection against the heavy projectiles of rifled guns.

A simple kind of splinter-proof shelter may consist of logs laid over a deep trench dug against the parapet, and covered with at least three or four feet of earth.

14. A gabionnade makes the best shelter for the *powder magazine*, which should be protected as completely as possible from the enemy's missiles; and which, as it should not be exposed to moisture, ought not to be under ground, unless the soil be perfectly dry.

A covering of green hides, with the hair underneath, is a good protection against incendiary compositions.

No field battery, caisson, or powder wagon, should be admitted within an intrenchment, unless completely sheltered from the enemy's fire.

15. Gabions make an excellent revetment for the *cheeks of embrasures*. Sand bags are also used for this

purpose. By keeping them constantly wetted, we may prevent the escape of the sand through the rents. If sand bags can be daubed with tar before filling them, it will render them much more durable.

The destruction of cheek revetments by the concussion of firing will be considerably diminished by covering them with raw hides.

At the siege of Sebastopol, the cheeks of embrasures in many of the Russian intrenchments were revetted with ship's boiler-iron water-tanks, cubes of four feet, filled with earth. They were found to be very strong. One of these cheeks was struck by thirteen shot and shell, and yet remained serviceable. In our late war, the cheeks of the embrasures of the Confederate Fort Wagner were revetted with quarter-inch plates of sheet iron.

16. All the revetting materials that have been mentioned are more or less elastic, and the degree in which they will resist the penetration of the enemy's projectiles is in direct proportion to their *elastic force.*

17. *Loopholes* for musketry may be formed on the top of the parapet by bags of earth, or layers of sods.

18. At the siege of Sebastopol, in some of the Russian works, thick rope matting was hung over the inside of the embrasures; which, being rifle-proof, was found to be a perfect screen for the gunners against the sharpshooters of the Allies. These curtains were called *rope-mantelets.* They were made of three thicknesses of rope

sewed together, and suspended from a horizontal spar which was laid across the top of the embrasure, and lashed to stout stakes four inches thick. A thick rim of the same material was wound round the gun, leaving a small aperture to sight through.

At Fort Wagner, another species of curtain or mantelet was used with good effect, consisting of a sheet-iron door hanging vertically on a horizontal axle. It was thrown open by pulling a cord attached to a lever. A rectangular aperture was pierced in the centre of the door, for sighting, and the passage of the rammer in loading.

At the same place, still another expedient was adopted for screening the gunners from our sharpshooters; after every discharge of a gun, the embrasure was rapidly filled up with sand-bags.

19. The rules and processes for the preparation of these auxiliary materials, involving a great variety of minute details, belong specially to the *art of engineering.*

IX.—Auxiliary Obstructions and Defences.

1. The chief *use of obstructions* is to keep the assailants as long as possible under the defenders' fire. To make this fire the more deadly, the obstructions are placed within short musketry range of the parapet. They consist usually of abatis, entanglements, trous-de-loup, crow's feet, chevaux-de-frise, inundations, and palisades.

2. *Abatis* are large limbs of trees, with the smaller

branches lopped off. They are laid in a horizontal position; the branches with sharpened ends, toward the assailants. They are placed in front of the ditch; sometimes in the ditch, at the foot of the counterscarp. When outside of the ditch, they should be so placed as not to intercept the defenders' fire; and should be screened by a glacis from the artillery fire of the assailants.

3. An *entanglement* is made by felling two trees in such a manner as to cause them to fall towards each other, with their branches entangled together. To render their removal the more difficult, the trees are not entirely severed from their trunks.

In forest warfare, entanglements constitute a ready and effective barricade.

At the siege of Duppel, in the late Danish war, a novel kind of entanglement was used by the Danes in the defence of their outworks, consisting of a net-work of iron wire; which, being invisible from the assailants' lines, suddenly checked the advance of the storming troops at short musketry range from the works, and compelled them to retire with serious loss. Wire obstructions were also successfully used by the Confederates in the defence of their works at Petersburg.

4. *Trous-de-loup* (or wolf-traps) are pit-falls dug in front of the ditch. They are arranged checkerwise, or in quincunx order, as it is called.

A stake is sometimes planted in them, with a sharpened end rising to within a few inches of the top. They

may be concealed by brush laid over their tops, and heaped over with earth. They should have a depth either of two and a half feet, or of eight feet, to prevent their being used as rifle-pits by the enemy's sharp-shooters; the former depth being too little, and the latter too great to allow of their use for such a purpose.

5. *Crow's feet* are sharp iron spikes so put together that when thrown on the ground one of the spikes is always uppermost. Boards with sharp barbed points, or even with points of nails projecting upwards through them, may be used as a substitute.

6. *Chevaux-de-frise* are horizontal beams armed with wooden lances pointed with iron, which project from them on every side.

Abatis, entanglements, crow's feet, and chevaux-de-frise, are chiefly useful against cavalry. They are best placed in front of a salient; which, as already explained, is the most vulnerable part of a work.

7. An *inundation* may be made by damming up a shallow stream, thus causing it to overflow. If a depth of about six feet cannot be obtained, trous-de-loup, covered over with a shallower sheet of water, may be effective; or water may be introduced into the ditch. Water in a ditch should have a depth of at least six feet.

8. *Palisades* are long and thick wooden palings, with their upper ends sharpened into long points.

To form a *palisading*, these are nailed at bottom to a long, horizontal beam, firmly embedded in the ground.

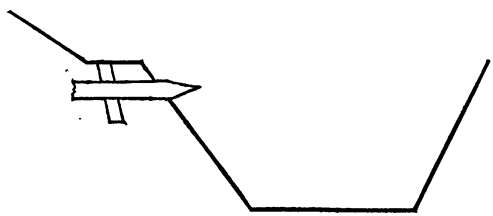
The palisades are a few inches apart, so as not to shelter the assailants from the fire of the work.

The best place for a palisading is at the foot of the counterscarp, its points at some inches below the crest. In this position, it is apparently the most effective obstacle that can be used; requiring a considerable time for its removal, and being close under the defenders' fire, while, at the same time, it is covered from the artillery fire of the assailants.

When planted outside of the ditch, a palisading must be protected by a traverse on each flank exposed to enfilade.

9. A *fraise* consists of a palisading placed horizontally, or but slightly inclined. The best place for it is in the scarp, just below the berm; it being there covered from the enemy's artillery fire. (FIG. 26.)

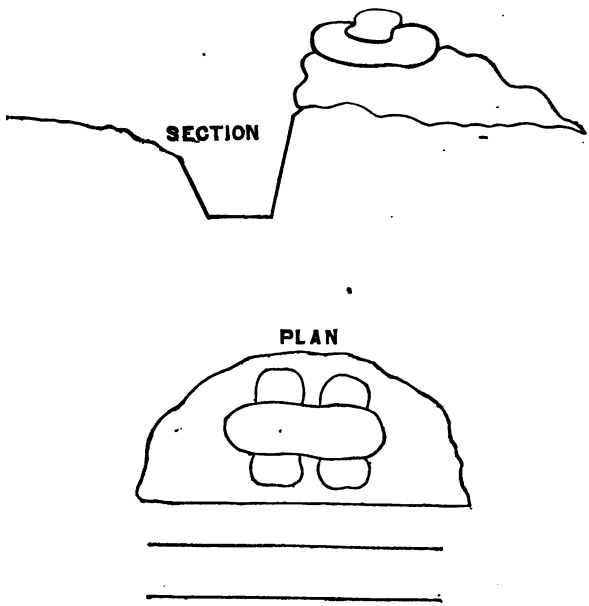
Figure 26.



It should not extend further out than the foot of the scarp, so as not to screen the assailants in the ditch from the shells, stones, logs, &c., rolled over on them from the parapet.

10. *Rifle-pits* are rather a defence than an obstruction. They are, properly, short trenches, three feet or more deep, dug at a greater or less distance in front of the ditch. The earth taken from them is thrown up in front, as a shelter against the enemy's fire. Sometimes three sand-bags are laid on the top of this little breast-work, to form a loophole for the musket or rifle. (FIG. 27.)

Figure 27.



These pits are occupied by two or three men only; but are now often made long enough to contain a considerable number of sharpshooters.

"Rifle-pits" became so comprehensive a term during our late war that it was applied to any kind of extemporized shelter from behind which sharpshooters could deliver a fire; as a pile of logs, or of stones, with earth heaped up against it.

Rifle-pits are not always merely auxiliary to other defences; they are sometimes used as independent works.

The greatly increased range of the new rifled infantry arms renders these pits very effective against artillery; for while, at the usual artillery ranges, the enemy's gunners are easily reached by the sharpshooters posted in them, their little parapets are too small a mark for the enemy's cannon.

They are most usefully located around a salient; for there, they not only cover the ground in front of the salient, but also rake the fronts of the two adjacent faces with a musketry fire.

When used as outworks, they are attended with one inconvenience. The ground in their rear being exposed, their occupants cannot be either withdrawn or reinforced but at the risk of great loss. To remedy this, the pits, when it is possible, should be connected with the main work by a covered way, or by zigzag trenches, like the *boyaux* used between the parallels in sieges.

When the flanks of a line of rifle-pits are exposed, they may be covered by abatis, by a breastwork of logs,

or by an earthen épaulement, according as they are threatened by cavalry, by infantry, or by artillery.

They should never be arranged in a long, straight line; for this would expose them to be enfiladed, and thus made untenable. They should be rather *en crémaillière;* as they would then have the advantages of an indented line.

Rifle-pits are not a new invention. They have been repeatedly used in sieges; and, at the siege of Sebastopol, very extensively, by both besiegers and besieged. At the French siege of Ciudad Rodrigo, in 1810, the state of the roads having delayed the arrival of his heavy artillery, Marshal Ney found himself without the usual means of keeping down the fire of the besieged upon the workmen in the trenches. He accordingly formed six companies of sharpshooters, and placed them in front of the trenches, in pits dug for their protection, containing three men each, with provisions and cartridges for twenty-four hours; and in these rifle-pits, he appears to have found an effectual substitute for his absent guns.

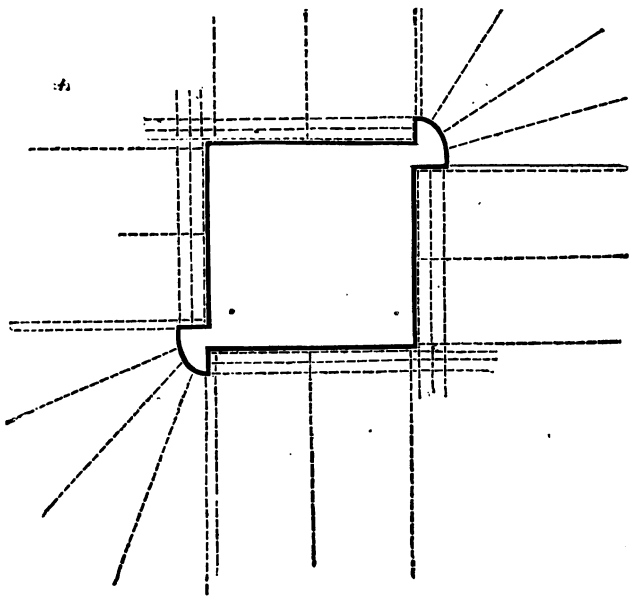
11. A *stockade* consists of a row of stout pickets, squared on two sides, so as to admit of their being placed in close contact. Small pickets are planted behind the interstices of the large ones, to make the shelter complete. It is used principally as a cover for the gorge, or other outlets of a work.

A stockade is not only an obstruction, but also a good

defence against musketry. An artillery fire, however, would soon level it.

An independent stockade work should be a sufficient defence against Indians; especially if strengthened by planked projections from the sides, called *tambours*, or by a log-house at each of two corners diagonally opposite; either of these giving a flanking defence to every side; the whole being loopholed. (FIG. 28.)

Figure 28.



12. In all cases where artillery cannot be brought against it, a *blockhouse* is the best kind of safety redoubt,

or réduit. It is, therefore, especially useful against Indians. It is built of heavy logs, laid horizontally, with a flat roof, also made of logs, and covered with earth a foot deep, as a protection against fire.

In the defence of Fort Mims, already mentioned, this precaution was neglected; and the building used as a blockhouse was set on fire by the flaming arrows shot on its roof by the Indians. The result was that the whole building was consumed, together with all the women and children, who had taken refuge within it.

13. A blockhouse is often made with two stories; the upper one overlapping the lower one on every side by several feet; the projection furnishing what is called a *machicoulis;* from which a fire is obtained on assailants underneath by loopholes pierced through the flooring. The building is loopholed throughout.

14. Another and extraordinary kind of auxiliary defence was used by Frederick the Great at his famous intrenched camp at Buntzelwitz; consisting of *curtains of batteries* between the detached field-works, protected in front by mines which could be exploded from the batteries.

X.—Of the Laying out and Profiling of the Work.

In reference to the accurate laying out of a field-work, *five different problems* may present themselves:

1. The work to be garrisoned by infantry alone:

The number of the garrison being given, what should be the dimensions of the work?

To enable us to solve this problem, three observations are necessary:

(1.) The dimensions of a work obviously depend on the extent of its perimeter, or line bounding it; that is to say, on the length of the parapet, or, which is the same thing, on the length of the interior crest. Now the length of this crest is entirely unaffected by the particular form of the work. We may bend a piece of wire into any shape we please, as, a circle, a square, a lunette, or a redan, and it remains always of the same length.

Thus, *to determine the dimensions of a proposed work, we must first ascertain what should be the length of its interior crest.*

(2.) While every part of the parapet should be occupied by the defenders, there should also always be a reserve of other troops drawn up on the terre-plein, ready in case of need to support the men at the parapet, or to repulse the assailants by a vigorous charge, if they should penetrate into the work. It is usual and proper for this reserve to consist of one third of the entire garrison.

Thus, *the troops manning the parapet should constitute but two thirds of the entire garrison.*

(3.) It is a maxim that *every linear yard of the parapet should be defended by at least one file*, that is, *two men;* the defenders being drawn up on the banquette in two ranks.

We are now ready for the problem.

Let the given number of the garrison be six hundred men. What should be the length of the interior crest?

Deducting one third of this number, or two hundred, for the reserve, there will remain four hundred men to occupy the parapet. But as each linear yard of it should be occupied by two men, the length of the interior crest should be two hundred yards. So that

The number of yards in the interior crest will be equal to one third of the number of the garrison.

To translate this into a general formula that will apply to all cases:

FORMULA A.

Let m represent the given number of men to compose the garrison.

Let y represent the required number of yards in the interior crest;

$$\text{Then } y = \frac{m}{3}$$

2. The second problem is: The work to be garrisoned by infantry alone; *The dimensions of the work being given, what should be the number of the garrison?*

Let the given number of yards in the interior crest be 200.

The number of men at the parapet will then be (200×2) 400; but as these constitute but two thirds of the garrison, the remaining third being the reserve, the whole number of the garrison will be six hundred men. Thus,—

The number of the garrison will be always three times the number of yards in the interior crest. Or, in general terms:

FORMULA B.

Let y represent the given number of yards in the interior crest, and m, the required number of the garrison;

$$\text{Then } m = 3y$$

3. The third problem is: The work to be garrisoned by both infantry and artillery; *The number of the garrison being given, and the number of guns, what should be the length of the interior crest?*

It is here necessary to observe that, when a work is armed with artillery, *six linear yards of the parapet must be allowed for each gun.*

Let the given number of the garrison be 600, and the number of guns, 6.

Now these 6 guns will require (6×6) 36 yards of the parapet; and (by Formula A) the garrison will require $\left(\frac{600}{3}\right)$ 200 yards more; making in all 236 yards; or, as expressed in

FORMULA C.

Let m represent the given number of the garrison;
" g " the given number of guns;
" y " the required number of yards in the interior crest.

Then $$y = \frac{m}{3} + 6g.$$

or, *The number of yards in the interior crest is one third of the number of the garrison, added to six times the number of guns.*

4. The fourth problem is: The work to be garrisoned by both infantry and artillery; *The number of yards in the interior crest being given, and also the number of guns, what should be the number of the garrison?*

Let the given number of yards in the interior crest be 236, and the given number of guns, 6.

The number of yards occupied by these 6 guns is (6 × 6) 36; leaving 200 yards for the infantry. Then (by Formula B) these 200 yards will require a garrison of (200 × 3) 600 men; and the general formula will be thus:

FORMULA D.

Let y represent the given number of yards in the interior crest;

" g " the given number of guns.

Then $y - 6g$ will, of course, stand for the remainder of the interior crest required for the infantry.

Now, let m represent the required number of the garrison;

Then $$m = 3\,(y - 6g);\ \text{or,}$$

The number of the garrison will be three times the remainder left by subtracting six times the number of guns from the number of yards in the interior crest.

5. The object of the fifth problem is *to equalize with accuracy the excavation of the ditch with the embankment of the parapet*, so that no time or labor may be thrown away through loose guessing.

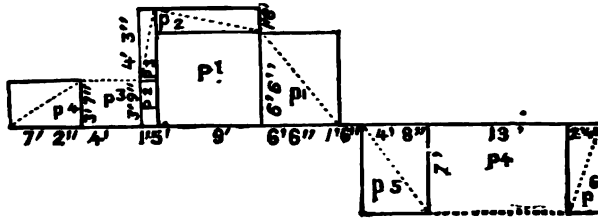
The quantity of earth to be excavated will be obviously in proportion to the proposed dimensions of the parapet. The number of solid or cubic feet of earth that will have to be excavated from each linear yard of the ditch is equal to the number of solid or cubic feet of earth required for each linear yard of the parapet. This last, therefore, is what is requisite to be ascertained.

Let us assume the proposed dimensions of the parapet to be the same as those marked on the diagram of the Profile (*ante*, FIG. 1), and that the depth of the ditch is to be seven feet.

It is evident that nothing remains to be ascertained but the *width* of the ditch; that the width of the ditch at the top will be determined by its width at the bottom, by simply adding to it the bases of the scarp and counterscarp slopes, which are fixed by rule (*ante*, Of the Profile, Par. 15); and that consequently, the precise problem to be solved is simply *the width of the ditch at the bottom.*

The whole mass of earth contained in a linear yard of the parapet is obviously made up of the parallelopipeds (FIG. 29.)

Figure 29.



marked P^1, P^2, and P^3, added to the half parallelopipeds p^1, p^2, p^3, and p^4.

The parallelopiped P^1, being 9 feet wide, 6′ 6″ high, and 3′ thick, contains of solid feet (9′ × 6′ 6″ × 3′)	175′	6″
The parallelopiped P^2, being 1′ 5″ wide, 3′ 9″ high, and 3′ thick, contains (1′ 5″ × 3′ 9″ × 3′)	15′	11″
The parallelopiped P^3, being 4′ wide, with an average height of 3′ 8″ and 3′ thick, contains (4′ × 3′ 8″ × 3′)	44′	0″
The half parallelopiped p^1 contains the half of (6′ 6″ × 6′ 6″ × 3′), or	63′	4″
The half parallelopiped p^2 contains the half of (9′ × 1′ 6″ × 3′), or	20′	3″
The half parallelopiped p^3 contains the half of (1′ 5″ × 4′ 3″ × 3′), or	9′	0″
The half parallelopiped p^4 contains the half of (7′ 2″ × 3′ 7″ × 3′), or	38′	6″
So that the total number of solid feet of earth required for each linear yard of the parapet is	366′	6″

As we have adopted seven feet for the depth of the ditch, the slope of the scarp will have a base of 4′ 8″, or two thirds of 7 feet, and that of the counterscarp, one of 2′ 4″ (*ante*, "Of the Profile," Par. 15).

Then the number of solid feet of earth furnished by the excavation of the half parallelopiped p^5 will be $\left(\frac{4' 8'' \times 7' \times 3'}{2}\right)$ or ..... 49′ 0″

That taken out from the half parallelopiped p^6 will be $\left(\frac{2' 4'' \times 7' \times 3'}{2}\right)$ or ..... 24′ 6″

Total of earth taken from the ditch at the scarp and at the counterscarp ..... 73′ 6″

Deducting this total from the total of 366′ 6″ required for the embankment ..... 366′ 6″

73′ 6″

leaves a balance of ..... 293′ 0″

solid feet of earth still wanting, and which must be taken from the space between the scarp and the counterscarp. This space constitutes the parallelopiped P^4; two of the dimensions of which, its height, seven feet, and its thickness, three feet, are already known. To obtain the other dimension, that is, the width, we have only to divide 293′, which is the whole number of solid feet it must contain, by the product of its other two dimensions, or (7′ × 3′) 21′; giving $\frac{293'}{21}$, or 13 feet for the

width; that is, the space to be left between the foot of the scarp and that of the counterscarp, or the width of the ditch at the bottom.

From this it will follow that the entire width of the ditch at the top must be 20 feet;

For the width at the bottom is	13′ 0″
Adding the base of the scarp slope.....	4′ 8″
And that of the counterscarp slope	2′ 4″
Will make the total width at the top....	20′ 0″

The above process may be compressed into a very simple formula.

FORMULA E.

Let P represent the sum, in solid feet, of all the parallelopipeds contained in a section of one linear yard of the parapet.

Let p represent the sum of all the half parallelopipeds in the same section.

S, the number of solid feet of earth taken out at the scarp.

C, the number taken out at the counterscarp.

D, the proposed depth of the ditch.

And W, the width required for the ditch at the bottom.

$$\text{Then, } W = \frac{(P + p) - (S + C).}{3\,D}$$

Or, *the width of the ditch at the bottom will be ascertained by subtracting the sum of solid feet of earth taken out at*

the scarp and at the counterscarp, from the number of solid feet in all the parallelopipeds and half parallelopipeds contained in a section of one linear yard of the parapet, and dividing this remainder by three times the depth of the ditch in feet.

The foregoing process may be shortened, as follows:

To make the solution as intelligible as possible, we have been supposing a solid or cubical section of one yard, or 3 feet wide, across both the parapet and the ditch. This has compelled us, in order to obtain the number of solid feet of earth to be excavated, to multiply in every instance by 3′; this being one of the three dimensions in each entire or half parallelopiped. Thus the number 3 is a factor common to the products relating to the parapet on the one hand and to the ditch on the other. Now, by a familiar rule of arithmetic, the equality between two products is not altered by striking out any factor common to them both. If we, therefore, strike out the common factor 3′ from both the sets of products, we shall arrive at the same result as before. In other words, instead of supposing the figures marked P and p to represent parallelopipeds and half parallelopipeds, we may regard them simply as they appear on the diagram; that is, as parallelograms and half parallelograms, having each two dimensions only, instead of three. This shortens the process for obtaining the respective values of P and p in the formula; which will then read thus:

$$W = \frac{(P + p) - (S + C)}{D}$$

From what has been said, we may deduce the following practical

RULE.

1. *Draw a vertical section of the parapet, marking upon it all its proposed dimensions; and fix a certain depth for the ditch.*

2. *Divide the entire parapet into parallelograms and half parallelograms, and draw the half parallelograms at the scarp and counterscarp, by adding the necessary lines for that purpose, as indicated in the diagram.*

3. *Calculate the areas of the respective parallelograms and half parallelograms, and add them together.*

4. *Add together the areas of the half parallelograms at the scarp and counterscarp; subtract this sum from the sum of the areas found in the parapet, and divide the remainder by the proposed depth of the ditch.*

The quotient will be the required width of the ditch at the bottom; from which its width at the top will be easily deduced, as before explained.

As earth occupies considerably more space on being freshly dug and thrown up than before, there will usually be left sufficient of surplus earth, either to furnish a glacis, or one or more traverses, or else to allow the earth thrown up to be well rammed, without diminishing the proposed dimensions of the parapet.

It is obvious that if additional earth be wanted for traverses, or other purposes, the ditch must be dug pro-

portionally wider, or deeper, or both; and that the above method may be so applied as to show to what extent this must be done.

6. As to the *time* required to throw up a work.

In common soils a soldier will excavate one cubic yard, or twenty-seven solid feet per hour; in loose or sandy soils, nearly double this. The work is divided into equal portions, or sections, which are executed simultaneously, by details of men for the purpose. All the sections being thus completed in the time required for one of them, *the number of hours required to complete the entire work is equal to the number of cubic yards contained in any one section.*

This time will obviously vary according to the greater or less favorableness of the soil.

7. If it be doubtful how much time will be allowed for the construction, it will be safest to *first complete the entire work with a feeble profile,* strengthening it afterwards, if there be time.

8. When pressed for time, the *cover most speedily obtained* consists of a trench, with a simple breastwork in front, made of the earth thrown up from it, without a ditch. A trench three feet deep, with a breastwork three feet high, thus made, giving a cover of six feet, may be completed in one third of the time required for a parapet six feet high; for one rank, it may be made in three hours; for two ranks, in five hours. (FIG. 30.)

A trench two and a half feet deep, with a breastwork

From what has been said, we may [illegible]
ing practical

RULE.

1. *Draw a vertical section* [illegible]
it all its proposed dimensio [illegible] ly, can be made
the ditch.

2. *Divide the ent* [illegible] ent cover for men
half parallelogram [illegible]
the scarp and c [illegible] *ground*, where a deep trench
that purpose [illegible] time and labor, the earth needed

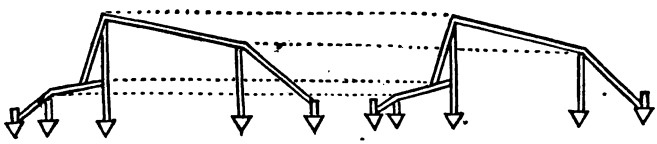
3. *Cal* [illegible] *the breastwork* may be obtained by digging a shal-
and hc [illegible] *trench on each* side of it. (FIG. 31.)

4 [illegible]

Figure 31.

10. *To* lay out the work on the ground, its outline is *first* traced. This is done, when there is time, by means *of* a slight framework made with poles, lathes, cords, and pickets, representing a profile of the parapet, and showing its dimensions. (FIG. 32.)

Figure 32.



The lines of the interior crest, the foot of the ban- [illegible] the foot of the exterior slope, and the scarp and

nterscarp crest are marked with the pick; and the
are placed at intervals of twenty or thirty yards.
operation is called *profiling*.

The exigencies of a campaign may sometimes
e materials of an intrenchment to be *prepared*
in order to be thrown up with the greatest
d.

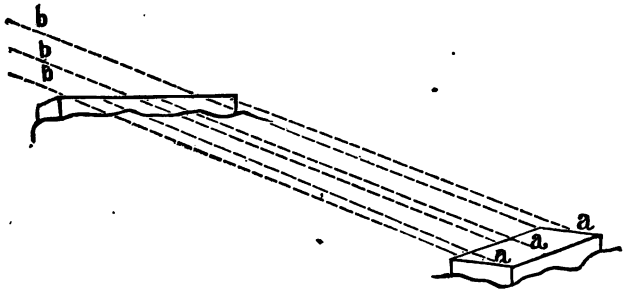
poleon had to cross with his army from the
nd of Lobau to the left bank of the Danube, in the face of one hundred and forty thousand Austrians drawn up to oppose him, he caused seven bridges to be thrown over the river in one night. The possession of these bridges was immediately made secure by an equal number of bridge-heads; the materials for which, consisting of fascines and sand-bags, had been secretly prepared on the island.

XI.—Of the Site.

The selection of the best site, or location, for an intrenchment is often but a choice of difficulties. Indeed, a site unobjectionable in every respect is seldom or never to be found.

1. The site *should not be commanded* by any ground within cannon shot; for this would expose the garrison to a plunging fire, if the enemy should erect a battery on the ground commanding it. The remedy for this inconvenience by defilading always requires considerable time and labor, is often but partial in its effect, and is sometimes impracticable altogether. (Fig. 33.)

Figure 33.



The diagram shows that a work commanded by a hostile fort or battery is exposed to a destructive plunging fire, to which it cannot respond with any effect. For, while the enemy's missiles a, a, a, would rain down everywhere upon the interior of the work commanded, those of the defenders b, b, b, would pass over the enemy's heads.

General St. Clair, who was intrusted with the important post of Ticonderoga, during our War of Independence, took no steps to occupy Sugar Hill, which commanded it; he having been informed that it was inaccessible. The British, nevertheless, having managed to reach its crest and plant a battery there, forced him to evacuate Ticonderoga, which thus fell into their power.

The same defect in regard to site was one of the causes of the loss by the Confederates of the important forts Henry and Donelson in our late war. Neither of these works was defensible; since Fort Henry was com-

manded by some uncompleted works on the opposite side of the river; and though Fort Donelson commanded the Cumberland river, it was itself commanded by a continuous range of hills in its rear.

2. No forest, ravine, or other *cover for the enemy's sharpshooters* should exist within musket or rifle range of the work.

It was a further defect in the site of the Confederate works at Fort Donelson that the thickly-timbered ridges which slightly commanded them, at not over three hundred yards, afforded an excellent cover for our sharpshooters.

3. As has been already intimated, the faces of a work should not be directed *towards points on which the enemy might plant guns to enfilade them;* and the choice of a site should be influenced by this consideration.

4. A work must not only not be commanded by, but its interior must never be exposed to, the enemy's fire. Therefore, if the work is to be erected *on a slope,* it must be so placed that its interior cannot be seen from without.

A fort placed below the brow of a hill leaves the ground behind it, up to the crest, exposed to the enemy's fire; so that the garrison can neither be reinforced, nor retreat, without the risk of loss.

5. If the work is to be armed with artillery, the best location for it is an eminence, or some commanding point, which will enable the guns *to see the ground to the greatest possible distance.*

But the ground below it should not be too steep for the play of our guns on the enemy's columns as they ascend to assault the work. Guns cannot be used with effect at a greater depression than six base to one perpendicular.

6. A work should not be placed so far back from the crest of a height as *to hide any portion of the slope from the parapet.*

At the siege of Kars, in the Crimean war, an unseen portion of ground, at one hundred and fifty yards below the work attacked, enabled the Russians to rally and form for seven assaults in succession.

7. The ground over which the enemy must approach to attack should, if possible, be seen by the work, *both in front and in flank,* to increase the effect of our fire on his advancing columns.

8. To save time and labor in digging the ditch and in raising the parapet, we should avail ourselves, as much as possible, of *natural inequalities of the ground.*

9. The nature of the ground in front should be such as to enable the defenders to *promptly issue* from the work, deploy their whole force on the outside, and take the offensive, in case of need.

10. If the work is to be *open in rear,* the ground behind it should be as inaccessible as possible to the enemy.

But if we have another work in rear, the ground between it and the gorge of the front work should not be so steep or so obstructed as to be inaccessible to our

own men in the rear work who may seek to recover the one in front from the enemy. At the siege of Sebastopol, after the capture of the Malakoff by the French, the Russians made several desperate efforts to ascend the steep slope in rear of it and recover it; but the road was so narrow, difficult, and obstructed, that all their attempts failed.

11. If the work is to be *occupied by a field battery*, the approaches to the gorge must be such as to enable the battery to easily drive in and out.

12. If the work is to be a Right Line, or one *easily assailable in flank*, the site should be so chosen that both flanks may receive protection from the natural features of the ground; as a precipice, a marsh, or a river.

13. A locality combining all these requisites of a good site will rarely, if ever, be found; but that site will, of course, be the best *which unites the greatest number of them.*

XII.—Works for the Defence of a Town or City.

1. If the object of an intrenchment be not merely to furnish a shelter for troops, or to strengthen a particular position, but *to defend a town or city*, such a location must be chosen as will best subserve this latter object; which must be regarded as the paramount one, to which all other considerations in respect to the choice of a site must be held subordinate.

2. Works for the defence of a place should be so

located as to *sweep all the approaches to it;* and when possible, with a cross fire.

3. There should be one or more works giving a *fire on the flank* of all troops marching to attack it.

A place situated, like San Francisco, at the extremity of a long and narrow peninsula, having a central ridge running through it, with commanding heights in front of the place, offers the most favorable conditions for defence. For, by means of batteries on the heights in front and on the central ridge, hostile columns, advancing along the peninsula on either side of the ridge, would be swept both in front and in flank.

4. The works should be far enough in advance of the place *to prevent the enemy's reaching it with shot or shell.* Otherwise, a bombardment may destroy the city; or the mere fear of one may bring such a pressure to bear from the inhabitants upon the garrisons of the works as to compel their surrender.

Considering the increased range of the new rifled artillery, by which a city may be reached, as was Charleston, in our late war, from a distance of five miles, a line of works at less than this distance from the place to be defended would hardly suffice to secure it from destruction.

5. It is not only by intrenchments commanding the approaches that a town or city may be defended. Works, wherever situated, which *command the place itself* with their fire, would render it untenable by the enemy after

he had carried it, and may thus operate to deter him from attacking.

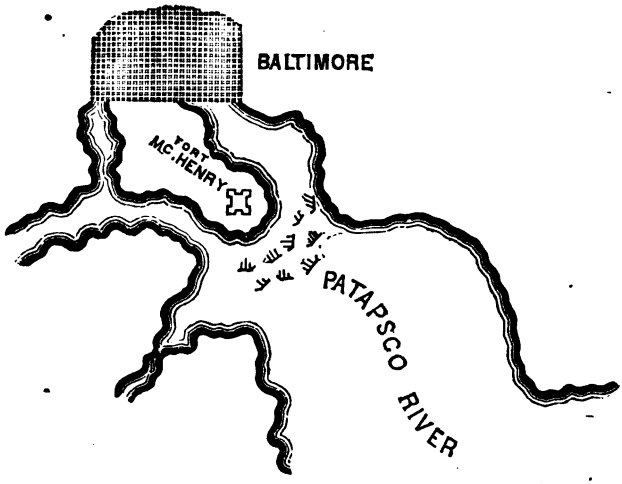
6. An examination of the neighborhood of a place will usually discover some point from which a battery might bombard it. The occupation of this point by the enemy would put the place in his power; as it would then have to surrender or be destroyed. Being thus the *topographical key* to the possession of the place, this point should be occupied by a strong redoubt; and if there be any other height that commands it within cannon-shot range, this also should be intrenched, and receive a battery.

7. Two instances will suffice to illustrate the importance, in choosing a site for an intrenchment for the defence of a city, of *accurately ascertaining* this topographical key to the possession of the place, and of *strongly fortifying it*, when found.

In 1814, a British force of five thousand men marched to attack Baltimore; which was defended on its land side by a long line of intrenchments, garrisoned by about nine thousand men, chiefly militia. Our troops met the enemy at North Point, at some distance in front of their works; and though most of them fought bravely, the misbehavior of one or two raw regiments, which let in the enemy on our left, compelled them to retire. The British did not follow; and, being satisfied that their force was too small to carry intrenchments so numerously defended, they relinquished their attempt to cap-

ture the city by an attack on the land side; preferring to move their fleet up the Patapsco river, and bombard it. (FIG. 34.) But to do this, it was necessary for the

Figure 34.



fleet to pass through a narrow arm of the river, commanded by a bastion redoubt called Fort McHenry. This fort was within cannon range of the city, which it also commanded. To the British, the reduction of Fort McHenry was therefore essential; first, as it commanded their only approach; and secondly, because it would secure to them the capture of the city; which, from the moment the fort should be occupied by an enemy, must either surrender or be destroyed by its fire. The fort being thus, from its location, the key to the possession of the city on the water side, the British ships took their

stations, and poured in upon it a concentrated fire of shot and shell. But this bombardment made no serious impression on the fort; so that the hostile fleet had no course left it but to weigh anchor and sail away; and the city was saved.

The other instance is furnished by the siege of Toulon by the French, in 1792. (FIG. 35.)

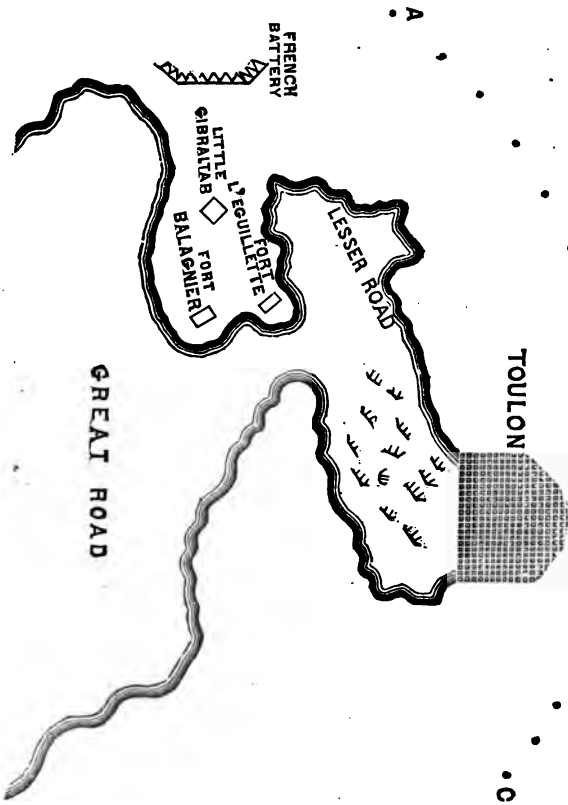


Figure 35.

The city was completely invested by the French on the land side. The general line of the besiegers' batteries is indicated by the dotted line A, B, C. The garrison consisted of fifteen or twenty thousand English and Spanish troops. A large fleet of the Allies lay in the harbor; which insured to them, at all times, the safe arrival of supplies and reinforcements, as well as the means of retreat; for the English were completely masters of the sea.

The siege had already lasted a considerable time; but, owing to the inexperience and inefficiency of their artillery, the besiegers had made little or no impression on the works of defence. So that, all the circumstances considered, there was no prospect of a speedy reduction of the place. To expedite matters, the French Government then sent Napoleon Bonaparte, then a young artillery officer, to act as chief of artillery at the siege.

On a thorough reconnoissance of the localities, Bonaparte reported to the general in command, substantially, as follows:

That the two forts, L'Eguillette and Le Balagnier, erected by the besieged at the foot of a certain promontory, commanded the shipping in the harbor, as also the passage between the Lesser Road and the Great Road, which was only about three quarters of a mile wide.

That the English, perceiving, to a certain extent, the importance of holding these two forts, had landed four thousand men on the promontory, and thrown up on the

crest of it a redoubt which they had christened "The Little Gibraltar," though its épaulements consisted of wood only, strengthened by palisades.

That a battery of 24-pounders, and mortars, properly placed, would, in forty-eight hours, destroy these épaulements, break down the palisades, and, by an incessant rain of shells on the interior of the work, make it untenable, and insure its capture by a column of picked troops.

That the moment The Little Gibraltar was won, the Allies would have to abandon the two forts at the foot of the promontory, because they were both commanded by it.

That after the taking of The Little Gibraltar, and of the two forts, the Allied fleet would have to withdraw instantly, or be set fire to and destroyed by red-hot shot from these batteries on the promontory.

That the departure of the fleet would deprive the garrison of their sole means of retreat on the fall of the place, an event which must then happen, sooner or later, since the fire of the promontory forts, barring the entrance to the harbor, would cut off all further supplies.

That rather than submit to the certain loss of fifteen or twenty thousand men, the Allies would withdraw not only their fleet, but the entire garrison, and abandon the place; and in this event, a day or two would be required for their embarkation.

Bonaparte was, therefore, of opinion, that within four

days after opening fire on "The Little Gibraltar" with the batteries proposed, Toulon would be evacuated by the Allies, and the French army would be in possession of the place.

These suggestions were adopted by the general in command, and carried into execution; and the prediction was fulfilled to the letter.

For this brilliant service, young Bonaparte, then a chef-de-bataillon only, and who was himself one of the foremost of the storming party in the assault on The Little Gibraltar, in which he was wounded, was made a brigadier-general.

The city of Baltimore was thus saved from capture through the erection of a strong and durable redoubt at that point which was the topographical key to its defence. On the other hand, Toulon was captured in spite of its strong defences, its numerous garrison, and its powerful auxiliary fleet, through the neglect of the besieged to fortify, in a solid and durable manner, the point which was the key to the possession of the place. But for this neglect, whatever may have been the final result of a protracted siege, the city certainly would not have been taken by a sort of coup-de-main.

To these instances may be added our loss of Harper's Ferry, with its garrison of eleven thousand men, in September, 1862. This place being commanded by Maryland Heights across the river, it was only on these heights that it could be successfully defended; and if

the commanding officer had caused them to be strongly intrenched and occupied, we might have been spared the calamity and the disgrace of that surrender.

7. But the most important consideration in the choice of a site for the defence of a city, is that the works *shall not be susceptible of being turned*, or avoided by the enemy; for, however strong and numerous they may be, they may thus be rendered entirely useless.

Thus in December, 1864, the Confederate General Hardee had attempted to defend the land approaches to Savannah by earthworks thrown up at about fifteen miles from the city, garrisoned by thirteen thousand men. But the Federal General Sherman having found means to turn them, the garrison had to retire into the city; and as we had secured all the Confederate lines of supply, Hardee had to choose between standing a siege which was certain to end in the reduction of the city and surrender of his force, and abandoning the place to us. He wisely chose the latter alternative.

So the capture of a single work may result in the turning of a strong and complete system of defences, and render them all useless. In January, 1865, the approaches to Wilmington from the sea, a distance of over thirty miles, were guarded by a series of works on both sides of Cape Fear River, and on the islands at its mouth. These works had been planned and executed by some of the most skilful and distinguished of the Confederate officers, and two years had been occupied in their construction. Fort Fisher, one of the principal

of them, was situated at about twenty miles below Wilmington, toward the extremity of the long and narrow peninsula which skirts the river on the east, separating it from the ocean. The beach above Fort Fisher, on the farther or ocean side of this peninsula, *being left entirely undefended*, a Federal force was landed there under General Terry, which, aided by the powerful co-operation of a fleet under Admiral Porter, soon captured the fort. This led to the following results:

(1.) The immediate abandonment of all the Confederate works on the peninsula below Fort Fisher; as also those on the neighboring islands, and on the opposite bank of the river; they being all commanded either by Fort Fisher, or by those which Fort Fisher commanded.

(2.) The evacuation of all the other forts below these works, both on the islands and on the main land, including Fort Caswell, one of the strongest permanent fortifications in America; these being now rendered useless for the defence of Wilmington, our forces having thrust themselves into a strong position above them

(3.) The landing of a Federal force on the western or main-land side of the river, which marched to Wilmington by a road passing some eleven miles behind Fort Anderson; thus turning, or avoiding, that immense work situated on the river, about six miles higher up than Fort Fisher.

(4.) The abandonment of this same Fort Anderson,

which being now turned by us, was no longer available for the defence of Wilmington; followed by its occupation by our troops.

(5.) The evacuation by the Confederate General Hokes' division of the "Sugar Loaf" lines of intrenchment across the peninsula; which, being directly opposite Fort Anderson, were now no longer tenable, being commanded by its guns. And finally, the evacuation of Wilmington itself, as the necessary consequence of the capture of all its defences.

On the other hand, works properly constructed, and bravely and skilfully defended, may be considered as impregnable, provided their location be such that they cannot be turned, as was the case with the intrenchments around Richmond; which kept our armies at bay for three years; and whose evacuation was caused, at last, only by the success of our operations elsewhere in the field.

8. Field-works for the *defence of approaches by water* are generally unreliable, for, in most cases, either a fleet of war vessels may steam by them without risk of very serious loss; as was shown by our capture of New Orleans, where we ran the gauntlet of the forts below it; or else, from their location, they are exposed to a combined attack by sea and land; an attack which few field-works can be expected to resist. Of this, our capture of Fort Fisher, the key to all the Confederate defences of Wilmington, affords a striking example.

Are
Interva

1. A
by stra

The d
(1.) I
fire.
(2.) T
2. Th
by subst
faces of
This is
pincers, t
But be

"100 MEMORIAL DRIVE"
OWNED BY THE NEW ENGLAND MUTUAL LIFE INSURANCE CO.

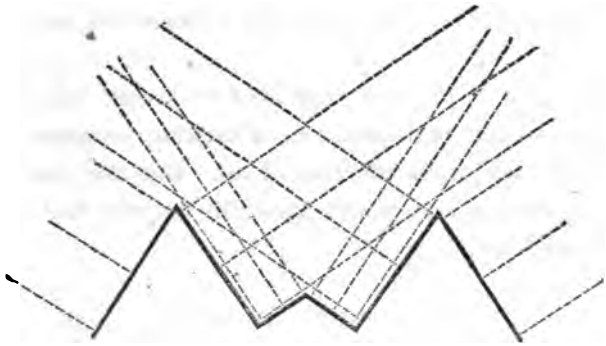
A Package No._____ 19

addressed to you has come to the package room.

Please call between 4 and 6:30 P. M.

Presenting long faces for

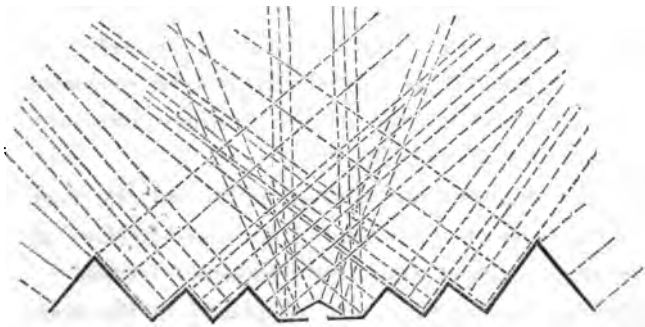
Figure 37.



enfilade, the Tenaille Line occupies so much space from front to rear, that it is suited to but few localities.

3. An *Indented Line* is generally the best; as, besides covering all the ground in front with cross fires, it requires but little depth, and thus adapts itself to hill sides and all kinds of irregular ground. (FIG. 38.)

Figure 38.



The general direction of the line must depend somewhat on the irregularities of the ground; following the

high ground, and leaving the valleys in front; so that all the ground in front may be commanded from the work.

4. A *Line of Bastions* may also be used; which, on account of the perfection of its flanking arrangements, would be the most effective of all. But the construction of such a line would generally require too much time and labor.

B. Lines with Intervals,

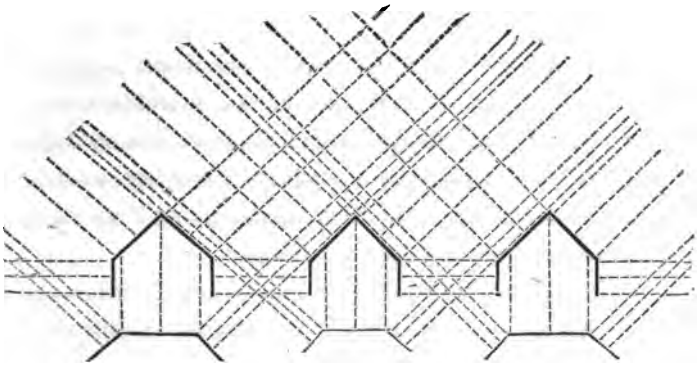
1. Are *detached works*, so arranged as to support each other; the ground between them being protected by their fire. The detached works are usually redans, lunettes, or redoubts, or a combination of two, or of all of these, according to circumstances, and the nature of the ground.

2. To give this system its full value, *retired works* must be used, so arranged as to flank the faces of those in front within the effective range of musketry, or at least of grape. This second line can be, moreover, so made as to render the advanced works untenable, if taken by the enemy. (Fig. 39.)

In the diagram, the retired works will be seen to flank the faces of the advanced ones, and to have, at the same time, a direct fire into the interior of them.

The heaviest guns should be placed in the works of the rear line; else the enemy, having obtained possession of them by carrying the works in front, would use

Figure 39.



them against us, and so have the advantage of us in the fire.

3. Lines may be *one* or *several in number*. Even a single line may be formidable, if its flanks are unassailable.

4. The *rear line* may consist of redoubts, but not the front line; else, on occupying them, the assailants would be covered from the works in rear; and could, moreover, use their rear sides against us.

5. By means of pan coupés, the works in the advanced line may be made to have a *direct fire to the front.*

6. When it can be avoided, the direction of a line of works should *not be convex* towards the enemy; for, by carrying one of the flank works, he would be enabled to take the remainder in reverse.

The general direction should be rather a crescent, with its horns towards the enemy. This form of a

high ground, and leaving the valley[illegible] gives also all the ground in front may be [illegible] work. [illegible] en, heretofore,

4. A *Line of Bastions* ma[illegible] salients of de- account of the perfection [illegible] e of the new rifled would be the most eff[illegible], must lead to a con- tion of such a line [illegible] nce, as well as of the time and labor. [illegible] of defence.

[illegible] of this improvement in fire-arms [illegible] ever works will be required to defend the

1. Are [illegible] ground.

other; [illegible] The flanks of a line, being the most assailable their [illegible] should *rest on some natural obstacle*, or else be lu[illegible] *protected by strong redoubts.*

Our line of intrenchments at Bermuda Hundred, *in the* late war, would seem to have been impreg- *nable.* One of its flanks resting on the James River, *and* the other on the Appomatox, and the distance *between* the two rivers being less than three miles, *it* is obvious that an attack in front would be over- whelmed by the fires from the works, combined with the enfilading fires from our gun-boats, which would moreover prevent the flanks themselves from being turned.

The great importance of securing the flanks of lines of intrenchment was strikingly illustrated by Welling- ton's celebrated Lines of Torres Vedras, in Portugal; which furnish also a remarkable instance of the powerful

ce such lines may have upon the success of mili-
ations.

Napoleon had subdued all his enemies except
o still kept alive the resistance of the people
h Peninsula, after all their organized forces
l in the field, by means of her army there
on. This army had been driven by supe-
bers into a narrow corner of the Peninsula, in
he neighborhood of Lisbon; and the whole English nation was daily expecting to hear of its destruction, or, at least, of its forced embarkation and return home. This event would have ended the war; for the English cabinet could then have no longer withstood the universal pressure upon it caused by the utter exhaustion of the people, and would have been compelled to make peace. Napoleon was perfectly aware that, if he could but destroy the English army, or drive it from Portugal, this would settle the fate of Europe, by leaving no enemy to oppose him in the Peninsula, or elsewhere. He confided this task, therefore, to the most reliable of his Marshals, Massena, "the darling child of Victory," with a powerful army of veterans.

The sagacious Wellington had long foreseen this emergency; and, being resolved to hold on to the Peninsula to the very last, had been quietly preparing for it by the construction of several lines of intrenchment, the outer one of which was some thirty miles in advance of Lisbon.

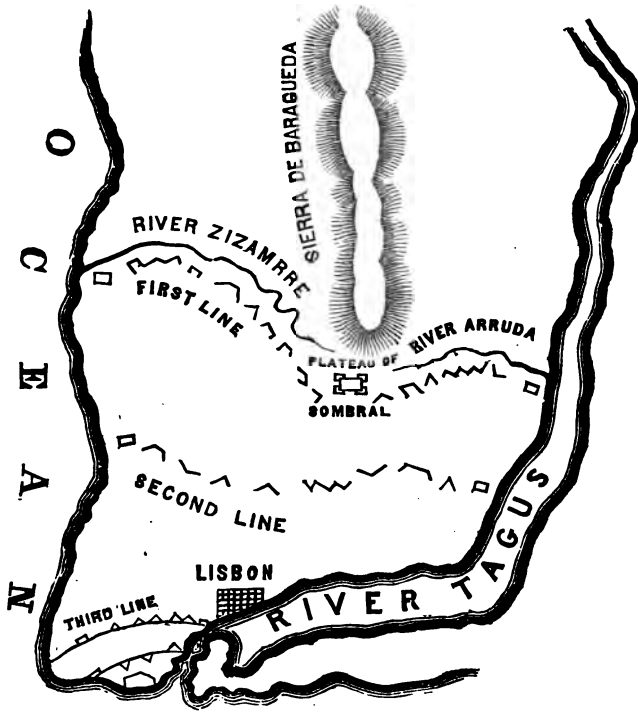
On Massena's approach, Wellington fell back with his

[illegible]

[illegible] the [illegible] line of [illegible] their [illegible] of [illegible] works. [illegible] [illegible] Valing- [illegible] [illegible]

the central plateau rose the long and lofty ridge of Baragueda, which, stretching away northerly, in a direction perpendicular to the English position, cut the ground in front of it into two parts, which were thus separated from each other by a difficult, if not impassable obstacle.

Figure 40.



It will be instructive to learn by what means Wellington had rendered so extensive a position impregnable.

(1.) The summits of the principal heights were crowned with strong works, which were armed with heavy guns, and so located as to mutually defend each other, and, at the same time, to command the avenues of approach to a great distance.

(2.) To render the less steep of the heights more difficult to be scaled, they were scarped by the pick and spade.

(3.) The cañons, or ravines, piercing here and there through the mountain chain, forming so many narrow defiles, were all defended by redoubts, or blocked by barricades, armed with artillery; as was also the narrow road skirting the bank of the Tagus.

(4.) The open plateau of Sobral, at the centre of the position, was defended by several strong works, so arranged as to cover the entire ground with a cross-fire from a great number of guns. Among them, on a commanding eminence, was a permanently fortified work, or citadel, which could be reduced only by a regular siege.

(5.) In front of the left of the position, where the heights were less precipitous, the river Zizambre was blocked at several points with barricades, causing an overflow; which kept the ground contiguous to its banks in a state of continual marsh.

(6.) The field-works were made as strong as possible, by means of glacis, wide ditches, stone scarps and magazines containing abundant supplies of ammuni-

tion. Some of them were closed works; others open at the gorge.

(7.) The works were armed according to their dimensions, with from six to fifty guns each, of calibres ranging from 6-pounders to 24-pounders. The heavy guns were mounted on ships' gun-carriages, furnished by the fleet, and were of such a description as to be immovable; thus rendering the use of them by the enemy impossible in the event of the works being captured.

(8.) The works were connected with each other in rear by wide and easy roads, which large numbers of the Portuguese peasantry had been long employed in constructing.

(9.) Wellington's headquarters were at the centre; from which radiated a system of telegraphic signals that afforded instant communication with every part of the line.

(10.) The extensive plateau at the centre afforded the English army ample room, in case of need, to form and engage, or to promptly issue to take the offensive, if a favorable opportunity should offer.

The Second Line was ten miles in rear of the first; with its flanks also supported on the Tagus and the ocean. It consisted of forts erected on a range of heights. This range was pierced only by a single narrow defile, so defended as to make it a perfect slaughter-pen for any force that should attempt to pass it.

The Third Line was below Lisbon, and consisted of a

vast bridge-head, formed by a semi-circular range of steep mountains; their crests bristling with field-works and batteries; flanked on the right by the broad mouth of the Tagus, and on the left by the sea. Its object was to cover the embarkation of the English army, with its horses, material, and stores, in the event of its being driven from both the outer lines.

In order to clearly understand how formidable was the obstacle presented by these lines, it is necessary to consider that the French had either to attack them in front, or to turn them.

That, in an attack in front, the only point offering the least chance of success was the open plateau of Sobral, in the centre of the first line. In assaulting at any other point, the French would have had to contend with almost insuperable difficulties of ground, as well as with the whole allied army, which would be sure to be concentrated at whatever point the attack might be made.

In attacking an extensive line of intrenchments, the only way to prevent a concentration of the enemy's force at the point of assault is by feigning an attack on one side, and then suddenly massing our troops for a real attack on another. But, in this case, the nature of the ground made such a manœuvre impossible; for the high and steep ridge of Baragueda, running perpendicularly up to the position itself, divided the ground in front of it into two parts, with the passage between them slow and difficult; so that the side on which the mass of the

troops should be shown would have to be the one of actual attack.

That, in attacking the centre, though this offered the most favorable ground, the French would still have desperate odds against them; for, while engaged with a force equal or superior in number, they would be under an overwhelming cross-fire from the works in their front and on their flanks.

That, even if they succeeded in forcing the centre, their success would be useless; as the ground conquered would be made untenable by the fire from the great redoubt, or citadel, which could be reduced only by a regular siege; and this the French were in no condition to undertake, having no siege artillery with them.

That, supposing that by great good fortune, though after terrible losses, they should succeed in carrying the works near Sobral, including the citadel redoubt itself, it would be only to find a similar line of works ten miles further on; the only passage through which was a narrow defile, so formidably defended as to render the task of forcing it apparently desperate.

For these reasons, an attack of the lines in front would have been rash in the extreme.

As for turning them:

This could be only by the Tagus, or by the ocean, the obstacles on which the flanks rested.

By the ocean, it was impossible. First, the French had no ships. Secondly, the English were completely

masters of the sea, having a large fleet at Lisbon, which, by means of telegraphic signals, could have been got under way in a few minutes after the first appearance of such a movement. Finally, between the left of the first line of works and the mouth of the Tagus, there was no point of safe debarkation on the coast.

As to the Tagus side: Wellington had taken the precaution of causing all the boats and other means of transport on the river, which was here broad and deep, to be collected and carried down to Lisbon; and the French had no pontoon train, or other means of crossing.

But supposing a pontoon train could have been sent for, or prepared on the spot, Massena must have effected his turning movement either with his whole force, or with a part of it.

(1.) If Massena had crossed the river with his whole force, to march down the left bank, recross in rear of the first line, or of both the outer lines, and thence to Lisbon, he would have abandoned to the English his only line of communication, which was on the right bank of the Tagus. As there were no means of supplying his army but by this line, and he would have had, at all events, the English army in his rear, nothing but the rarest good fortune could have saved him from ruin.

(2.) If, on the other hand, he had divided his army, sending one part down the Tagus to turn the Lines, and keeping the other part in front of them, this would have

led to still more certain destruction; for, in that case, as Massena's whole force consisted of but forty-five thousand men, the Allied army, numbering some fifty thousand men, exclusive of the garrisons of the works, could have instantly debouched and crushed the fraction of the French army left in its front; and then rapidly countermarching, could have overwhelmed the remainder also, by superior numbers.

Thus the lines of Torres Vedras were impregnable; since they could neither be forced nor turned. At least, an attempt to do either would have probably resulted only in the destruction, partial or total, of the French army.

9. The *advantage of double lines* of intrenchment is, that the enemy will have, at all events, two battles to fight to gain his point, instead of one; and though a vigorous and determined attack may sometimes succeed in taking the first line, it is by no means certain that this will be made where a successful attack on a second line must follow, to enable the assailants to derive any benefit from the capture of the first. Whether the attack on the advanced line succeed or fail, it can scarcely be without the assailants suffering severe loss from a portion only of the defending forces; which, being behind cover, will have sustained comparatively but little loss themselves; the reserves in the rear line being still fresh. After taking these advanced works, the assailants will still be exposed to fearful slaughter, till they

masters of the [illegible] the retired ones, which
by means [illegible] stronger than the first.
under wa[illegible] often operate to prevent any
of such [illegible] at all. Indeed, it is a maxim in
first li[illegible] position should ever be attacked,
was [illegible]

[illegible] lines have *one disadvantage*. The
ca[illegible] advanced line, considering it not abso-
t[illegible] to hold the works of that line, regard-
ing them as mere outposts to the works in rear, will be
apt not to make an obstinate defence of them, and
therefore to retreat from them too soon. And if, on the
other hand, they do hold them to the last extremity,
that is, till they have met the enemy on the parapet, a
retreat then will be hurried and disorderly, and the
assailants may enter the rear works pell-mell with them.

11. Whenever several lines are used, they should be connected by *covered ways*, or trenches, to enable us to send reinforcements to points strongly pressed, without exposing the troops to serious loss on the way. So, in order to facilitate a prompt and concentrated débouché to the front, for the purpose of a sudden and vigorous attack, these covered ways are of the greatest importance; and, obviously, the wider they are made, the better will they subserve this object.

12. Lines with Intervals are preferable to Continuous Lines; *which, when attacked vigorously are generally forced.* For, in a Continuous Line,

(1.) The troops are too much dispersed. Having to remain extended over the entire line to the last moment, they cannot usually concentrate in time at the point where the enemy masses his serious attack.

(2.) If any one point of the line is gained by the enemy, the whole line is apt to be abandoned; for when the defenders, who are constantly looking out for their flanks, suddenly see them turned, the instinct to retire is usually irresistible.

(3.) As Continuous Lines leave no freedom for manœuvring, or for deploying to take the offensive, they tend to paralyze the defence by rendering it merely passive. A defence, to be a good one, should be active whenever circumstances admit. Prompt counter attacks are often essential to a successful defence. Napoleon observed that a river, though broad and rapid, is a poor line of defence, without secure points for passing to the offensive; and this same objection is applicable to a continuous line of intrenchment.

But Continuous Lines are best for undisciplined troops, not accustomed to manœuvre, and who would naturally want confidence in themselves in the open field.

They are also less objectionable where they are of very limited extent, the flanks being, at the same time, perfectly secure; as, for instance, a line of intrenchment closing a pass between steep mountains, or a line between the banks of two large rivers, or other impassable obstacles.

13. Intrenching on an expected battle field is attended with several *serious disadvantages:*

(1.) An intrenched force always feels itself inferior to the enemy. This feeling robs it of half its strength; and troops accustomed to rely for their safety on an obstacle, when they see that obstacle forced, are apt to give up further resistance.

(2.) It is not always easy to get even veteran troops to come out from behind defences, however slight, to meet the enemy's storm of fire in the open field; and with raw troops this is often impossible, so tenaciously do they cling to cover.

(3.) If the intrenched position be obstinately held to the last, and be then forced, there will seldom be time to take up a new one of any kind, so that a mere repulse may become a rout. And yet, if it be not so held, it is not of much use.

(4.) To prevent our defences being forced, we must keep them all fully manned. This robs us of all chances of winning a victory by means of a prompt offensive with a strong concentration of troops.

(5.) From the moment an intrenched position is turned, it is no longer of any value; and such a position is usually turnable; since, while the intrenched force is chained to its lines, the movements of the enemy are free and untrammelled.

At the battle of Nashville, the Confederate General Hood had carefully chosen two positions, one in rear of

the other, in which to receive our attack; and had employed much time and labor in intrenching them. His first line was six miles in length, stretching over the wooded sides and crests of a series of high hills, which were covered with breastworks, rifle-pits, and abatis, with guns sweeping all the approaches. But on the first day of the battle this formidable line was made untenable by his left being smashed in and turned; compelling him to fall back to his second line, which was only three miles in length, and stronger, because more concentrated. Nevertheless, on the second day, by the turning of his flank and rear by Wilson's cavalry, combined with Smith's and Schofield's attack on his left, he was forced to abandon all his defences, and his retreat soon became a Waterloo rout.

So, at the battle of Fredericksburg, nothing saved the Confederates' intrenched lines from being turned by the capture of the heights on their right rear, but the extraordinary inertness of the commander who, with a force of over fifty thousand men, was specially intrusted with that duty.

14. On the other hand, in the following cases, *intrenching may be wisely resorted to:*

(1.) When the face of the country is such that it would be otherwise impossible to guard against a sudden attack by surprise.

(2.) When apparently necessary to save an inferior force from capture or destruction by greatly superior numbers.

(3.) When used to strengthen a particular part of our line of battle that we are obliged to leave comparatively weak.

(4.) When used to establish a rallying point in rear, in case of reverse; like the breastworks thrown up by us at the battle of Nashville, as an inner or reserve line.

(5.) When used simply to strengthen that point which will apparently be the key to our position in the impending battle.

XIV.—Attack on Intrenchments.

1. It is a military blunder, as well as a crime, to send troops to be slaughtered, when the object in view may be attained without the sacrifice of any part of our force. Hence the maxim, *never to attack a fortified position that may be turned.*

2. We should never attack a work, whether by surprise or by open force, without *as full knowledge as can be got* of the strength of the work, the number of its garrison, its interior arrangements, its weak and its strong points, the approaches to it in front, flank, and rear, the neighboring ground, and the strength and position of the covering forces, if any there be. This information may often be obtained from spies, prisoners, or deserters; but as these sources are more or less unreliable, it should be confirmed, when practicable, by actual reconnoissances made by our engineer officers.

3. In order to exhibit all the principles relating to the attack on intrenchments, the works attacked will be supposed to be of the *greatest strength ever found in mere field-works.* For the attack of slighter works, the same principles will apply, with such modifications as will be obvious.

4. Intrenchments are attacked, first by *bombardment,* and then by *assault.*

We shall consider

First, THE BOMBARDMENT.

Secondly, THE ASSAULT.

Thirdly, THE ATTACK ON LINES OF INTRENCHMENT.

A. THE BOMBARDMENT.

To assault a work *before it has been bombarded* by artillery usually leads to no other result than a waste of life; as was shown by our bloody repulses at Vicksburg, Port Hudson, Fort Wagner, and on James' Island. A way should be first cleared for our assaulting columns by the levelling of some portion of the parapet, the sweeping away of the auxiliary obstructions and defences, the silencing of the guns, the dilapidation of the interior work, and the disabling of a portion of the garrison, with the dispiriting of the remainder. Our artillery should endeavor to effect all these objects; and until they are effected in some considerable degree, if the defenders only exhibit ordinary steadiness, the success of the most desperate assault would be, at least,

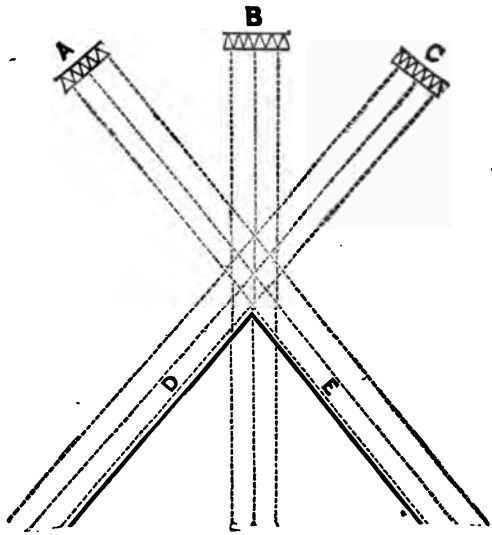
doubtful. In fact, in the attack of intrenchments, it is mainly the artillery that should fight the battle. The infantry should have only to complete the victory and secure its fruits.

In a bombardment, the first step to be taken is to find the best positions for the

(1.) *Planting of Batteries.*

1. Usually, the best position for a battery is *opposite a salient* of the work attacked; as at A, B, and C, in the diagram. (FIG. 41).

Figure 41.



For,

(1.) We thus obtain a converging fire upon the salient;

which must destroy it, leaving a wide breach for the assault.

(2.) Our projectiles will thereby sweep the work in the direction of its greatest dimension; thus, probably, disabling more of the defenders.

(3.) The breach will be made at the point the most favorable for assault; as the storming party, advancing over ground not under the enemy's fire, and covered at the same time by the cross fire of our own batteries, would sustain the least possible loss by the way.

(4.) We thus obtain also an enfilading fire along the faces D and E, forming the salient; which must soon dismount the defenders' guns placed in them.

(5.) Our batteries, in this position, are not usually under fire from the work; so that our fire cannot be replied to.

2. Batteries may also be properly planted on that side of the work having the *weakest flank defence;* thus favoring the assault.

3. If our attack be directed against a face of the work, one or more batteries should be planted to give *an enfilading fire along the face attacked,* and also along the ground directly in front of it; for, by these fires, the guns of the work are soon dismounted, the defenders on the terre-plein, out of sight, are often disabled, and the obstacles in front of the parapet destroyed.

4. It will be advantageous to plant a battery so as to obtain a fire *on the magazine* of the work attacked, if

above ground. In our attack on Fort Pulaski this measure was adopted, and the brick revetment of the magazine was partly destroyed. This was apparently the immediate cause of the surrender of the fort; for, in an hour's time, the magazine would probably blow up by our fire; and, at the time of the surrender, the entire loss of the garrison was only two or three wounded.

5. Batteries are covered from the enemy's fire by an *épaulement*, or parapet; which may be revetted, like that of an intrenchment.

6. Counter batteries, or those intended to batter the work in front, should be *parallel* to the face attacked; enfilading batteries, *perpendicular*, and those directed against the cheeks of embrasures, *oblique* to it.

7. Our batteries should be as well protected as possible by the nature of the ground from *capture by the enemy*, as well as from *enfilade by his batteries;* to effect which latter object, flank traverses may sometimes be necessary.

8. When the guns are placed in a trench dug in the ground, the earth from it being thrown up in front as an épaulement, in lieu of a parapet and ditch, this is called a *sunken battery*. As these batteries require less time and labor for their construction, they give cover more speedily; but as they have no command, their fire is very apt to be masked by obstructions.

9. At the siege of Fort Pulaski, our most exposed batteries were planted directly *in front of an extensive*

marsh. This was found to be no inconsiderable protection; for, while the Confederates' shells were constantly falling within a few yards of the batteries, most of them sank in the marsh, and were there extinguished. Our entire loss in the bombardment was only one killed.

10. A great number of guns should not be assembled in one battery, and the batteries themselves should be *as much scattered as possible*, in order to prevent a heavy concentration of fire upon them by the enemy.

11. Owing to the elongated, conical form of rifle projectiles, they are easily deflected from their course by even slight obstacles; so that, against intrenchments, and the obstacles in front of them, the effects of *rifled guns* are not as certain as those of smooth bores.

(2.) *The Fire.*

1. The *objects* of a bombardment are, by means of an incessant fire of ball and shell—

To dismount the enemy's guns;

To make a breach in the parapet for the assault;

To destroy all abatis and other obstacles in front of the work;

And to cause such loss and intimidation among the garrison as will facilitate its capture by assault.

2. To *dismount the guns*, a desultory fire will be entirely insufficient.

In General Butler's attempt to capture Fort Fisher, in December, 1864, the fire of our fleet, which was chiefly

shelling, was so diffuse that it had scarcely any other effect than to keep the men from their guns. But little damage was done to the guns themselves, or to the work; so that an assault was too dangerous to be tried. But in the attack in January following, the fleet fire was directed chiefly upon the guns, and upon the palisades. By this fire, nearly all the guns on the land face being dismounted, and large gaps being made in the palisading, the assault on that side was made easy, and the work was carried.

The surest method is to concentrate several guns at a time on a single embrasure; by this means, also, more of our shot will penetrate into the work, disabling the defenders.

Where the object is merely to keep the men from their guns, rapid firing is the best, and, if we are near enough, with grape or canister; if too distant for this, with shells. But the fire to dismount guns must be slow, to admit of an accurate aim, and with solid shot.

3. To *breach the parapet*, a concentrated fire must be kept up on some particular section of it, until it has crumbled into the ditch; thus filling it up, and enabling the assaulting troops to pass over it without delay.

4. To *destroy the obstacles in front* of the work, an enfilading, ricochet fire is the most effective. This fire, if very heavy, may also cut the exploding wires or fuses of mines, and thus prevent their explosion; as was the

case at Fort Fisher. For this purpose, and for the destruction of palisading, shells are better adapted than round shot.

To obtain a ricochet fire, small charges are necessary. Moderate, or shattering charges, should also be used against all wooden obstacles or defences. Full charges, especially with rifled guns, will cause the projectile to simply pass through the object, instead of demolishing it, or making splinters.

5. Before commencing the fire, in order that our heavy pieces may see where to aim, we may compel the enemy to *unmask his batteries* by throwing forward, for a short time, some light guns; which, by a few volleys of grape, will draw the enemy's fire.

6. To light up the enemy's works at night, *fire-balls* are thrown around them from mortars. These are filled with loaded shells, or with loaded pistol-barrels, to deter the enemy from approaching them.

In our late war, calcium lights were successfully used for the same purpose.

7. If the work we are attacking have within it *an interior redoubt*, the bombardment should not be deemed completed until this has been destroyed, or so damaged by our fire as to lay it open to assault. For, otherwise, after our troops shall have carried the main work, they may find it rendered untenable. If built of combustible materials, it may be fired by shells, or by rockets.

8. As a further preparation for the assault, shells

should be thrown into the work *every few minutes during the night*, for the purpose of wearing out the garrison through want of sleep, and of deterring them from attempting to stop breaches, or repair damages. This purpose will be best effected by firing at irregular intervals.

9. Immediately before the rush of the storming columns, the interior of the work should be overwhelmed with *a fire of shells*, in order to drive the garrison into their bomb-proofs, or other shelters, and thus prevent their resistance to our assault.

B. The Assault.

We will consider

First. When to assault;

Secondly. The formation for assault;

Thirdly. How to assault.

(1.) *When to Assault.*

1. Though, as a general rule, a bombardment should precede an assault, there are, nevertheless, *exceptional cases* in which a work may properly be stormed without awaiting the effect of a bombardment.

(1.) Where succors for the work are momentarily expected to arrive, and its capture is so important as to justify the risk of a considerable sacrifice of life in an attempt to carry it before their arrival.

In December, 1864, it was important for General

Sherman, on approaching Savannah, to open a communication by the Ogeechee River with our fleet in Ossabaw Sound, in order to obtain a water base for supplies absolutely necessary for the reduction of Savannah. But this could not be done till the capture of the Confederate Fort McAllister, situate at about six miles from the Sound, and which commanded the river. This fort was an extensive earth-work of great strength, with ditch, abatis, and palisading. A Confederate force of eight thousand men was rapidly approaching from the South to protect it. One day's delay might enable the reinforcement to arrive; which would have rendered its capture, except by regular approaches, impossible. General Sherman ordered its immediate assault by a force of nine regiments. Its capture was not a difficult task, the small garrison of two hundred men being entirely insufficient to defend it. But even if the work had been so strongly garrisoned as to give us a bloody repulse, the assault, under the circumstances, would have been justifiable.

(2.) Where the work is so weak or so feebly garrisoned as to make it improbable it could resist an assault.

(3.) Where our arrival is a surprise, and the garrison is probably unprepared to make a good defence.

The surprise of an undisciplined garrison will be generally successful.

(4.) On defeating troops posted outside of the work,

and driving them into it, if we rush in pell-mell with them, we should paralyze the fire of the work, which could not then be used without destroying both friend and foe; and by means of the disorder and confusion that would ensue, we should probably succeed in carrying it.

In the Crimean War, if the Allies had followed close at the heels of the retreating Russians after the battle of the Alma, they would have carried the defences of Sebastopol.

At the battle of Long Island, in our War of Independence, the British drove the Americans into their intrenched lines. If Lord Howe had not then halted, he would have destroyed or captured our whole army.

(5.) Finally, a large army, engaged in a capital operation, which may end the war, or decide the fate of the campaign, and the success of which may be jeoparded by delay, should not allow its march to be arrested by a few field-works. In such a case, time is of more value than blood, and the importance of the object in view may justify, nay, even require an immediate assault.

Our late war furnishes one of the most striking illustrations of this principle to be found in military history. In April, 1862, General McClellan, with an army of over one hundred thousand men, and fifty-two field batteries, besides a powerful siege train, on its march up the York Peninsula to capture Richmond (an event, that, in the opinion of its commander, would have ended the war),

was stopped by a line of intrenchments extending some thirteen miles, and garrisoned by only five thousand men, exclusive of six thousand guarding the flank defences. Every day's delay strengthened the enemy, who was known to be rapidly concentrating from every quarter, and adding to the defences of his capital. A serious assault on any part of such a line, aided by our numerous and formidable artillery, must have forced it, and opened the way to Richmond. Nevertheless, the Federal Commander, instead of making any attempt to do what was so urgently necessary, and without even a single vigorous reconnoissance, which would have disclosed the weakness of the Confederate line, wasted a whole month in preparations to besiege Yorktown; which place the enemy then evacuated, having gained all the time he needed to save his capital and make our campaign a failure.

2. The assault should be postponed until it can be made from the *nearest point possible to the work.* The less the distance the storming party has to clear, the greater will be the chance of success.

At the siege of Sebastopol, the French made their first assault on the Malakoff from the distance of four hundred yards. They were repulsed, with the loss of two thousand five hundred killed and wounded. They continued their approaches, until, in their final assault, they had but thirty-two paces to run over. They then carried the work, with the loss of but eleven men.

The English made their assault at the same time on the Redan, but from the distance of two hundred and twenty-five yards; and their assault failed, chiefly from their too great distance from the work.

3. The best time for an assault *by surprise* is just before day, when guards are everywhere least vigilant. One or more false attacks, in such case, should always be made, to distract the enemy, and divert his attention from the true one; and if these be made a little before the true attack, they may moreover serve to make the enemy withdraw some of his troops from the point assaulted.

It is a disadvantage attending very early morning attacks, that the troops, having had but little rest, go to the assault fatigued and excited.

4. *Night attacks* are always objectionable. We may be ready at night, but should wait for daybreak to make the assault. In darkness, friend cannot be distinguished from foe; the men get separated from their corps, and the different corps from each other; no combined action can be relied on, and disorder must more or less prevail. Besides this, in the dark, examples of gallantry are thrown away, and timidity is infectious. The two night attacks made by our troops on Fort Wagner, in July, 1863, were repulsed with great slaughter.

(2.) *Formation for Assault.*

1. The assaulting column should consist of *an entire corps*, as a battalion, or a brigade, and not of detach-

ments from different ones; in which both mutual confidence and the *esprit de corps* will be wanting.

The storming party, which leads the attack, should be composed of volunteers for the occasion, or of picked troops.

2. The column should have its *advance*, or storming party, its *main body*, and its *reserve*, to support the column, or to cover its retreat if repulsed. The reserve should be near enough for prompt support; but not so near as to be in danger of being thrown into disorder by the repulse of the troops in front.

3. The storming party should be preceded by a *detachment of sharpshooters*, destined, on arriving near the work, to deploy and cover the storming, by keeping down the fire from the parapet. If the marines designed for this service, in our attack on Fort Fisher, had marched in front of the navy column, instead of behind it, they would have been ready to perform their task, and the sailors would not have been driven back by the fire from the work.

But great care should be taken to prevent these sharpshooters from opening fire until their arrival on the ground where they are to deploy. The first musket fired from an assaulting column during its march is generally the signal of failure. Not only is the fire of troops marching to assault an intrenchment usually ineffective, but they lose by it their momentum and their *élan*, and are meanwhile exposed to a murderous fire from the

work. In General Banks' unsuccessful assault on the works at Port Hudson, one of the errors committed was opening the attack by a line of skirmishers thrown out in front of the assaulting columns.

4. A detachment of *engineer troops* precedes the whole, to remove obstacles. They should carry with them bags of powder, with fuses attached, to blow down obstructions; and, where the field of operation is of much extent, intrenching tools, to enable the troops to hold the ground won.

To blow down a strong palisading, a leathern bag of powder, containing from thirty to fifty pounds, is provided, with a strong gimlet or copper nail, by which to fasten it to the palisading.

A second detachment of engineer troops follows the storming party, to complete the work of the first by widening the openings, and otherwise facilitating the passage of the main column.

5. The storming party should also be accompanied by an *engineer officer*, who can judge of the strength or weakness of different parts of the work, and who would be competent to advise in unexpected emergencies, and to direct such operations as may suddenly become necessary.

In our unsuccessful assault on the Petersburg lines, in July, 1864, no engineer officers or working parties appear to have been sent along with the assaulting columns.

6. The *front rank* of the storming party should carry

fascines, or bundles of straw to fill up the ditch, and to cover pickets and spikes. The fascines will serve also as bucklers against musket or rifle-balls. The leading troops may also carry with them strong hurdles, or planks, to cover trous de loup.

At the siege of Dunkirk, in 1658, the outer works of which were defended in front by an inundation, the assaulting troops, by the use of great number of fascines, hurdles, and planks, were enabled to pass through the water with their arms at a shoulder.

7. The assaulting column in the Confederate attack on our works at Lexington, Missouri, in 1861, used a singular species of cover against our fire, consisting of a *movable parapet* of bales of hemp, which they rolled along in front of them as they advanced. These bales, being kept soaked with water, resisted all our attempts to set them on fire with red-hot shot. The assault proved successful.

(3.) *How to Assault.*

1. It would be rash in the highest degree to assault an intrenchment the only approach to which is *through a defile*, or over a narrow strip of land, or peninsula; unless the fire of the work has been completely silenced, and the defenders driven from the parapets. For the enemy's artillery fire concentrated on the assaulting column would be very destructive; and if the column should be checked by any obstacle, a vigorous sortie from the

work would probably rout it, the men being cooped up in a position in which they could not deploy or manœuvre.

In July, 1863, our assault on Fort Wagner, over a narrow peninsula of sand, in one place only twenty-five yards wide, met with a bloody repulse. But, in our second assault, the column was held back until the enemy's guns were silenced, and the garrison driven into their bomb-proofs. This assault was temporarily successful; for our troops got possession of a part of the work, and held it for three hours. But for the disorder and uncertainty caused by the darkness, we should have probably completed the capture.

2. When the fire of the work has been entirely, or in a considerable degree silenced, and we are ready to assault, *demonstrations* should be made on several points at once, to prevent the garrison from concentrating on the one to be really attacked.

Though we must reserve as large a force as possible for our real attack, the stronger we can make the demonstration, the more completely it will answer its purpose. This was illustrated in our attack on Fort Fisher, in January, 1865, where the navy assaulting column of two thousand men deceived the garrison by its strength, and induced them, supposing it to be our main attack, to withdraw many of their troops from the opposite side in order to repulse it. The diversion thereby caused enabled our land force to approach the weakened side and enter the work, which it finally carried.

3. But our demonstrations *should not be real attacks.* The principle of concentration is as important here as in other military operations. To make success sure, we must attack at one point only, and be ready to sustain the attack there with our masses. This principle was disregarded in General Grant's assault on the Confederate works at Vicksburg, on the 22d of May, 1863; when a serious attack was made upon all of them at once; our line being spread over some six or eight miles of ground, and thus weak by attenuation. The result, as was to be expected, was a repulse, in which we lost very heavily.

4. But if we are to commit the error of attacking everywhere, with our whole force, we should at least see to it that our attack is *simultaneous;* otherwise the enemy will be able to concentrate and repulse us at each point successively; as in our assault at Port Hudson, where each of our three commanders appears to have been left to choose his own time for advancing.

5. But where the work attacked is *insufficiently garrisoned,* and we have *abundance of troops for the purpose,* a simultaneous and vigorous attack on all sides of the work will be sure to disclose one or more weak points through which we may penetrate and capture it; and this course was properly taken in our assault on Fort McAllister, in December, 1864.

6. A false or *sham* attack is best made by infantry, in dispersed order, with a great deal of firing and noise;

accompanied, if practicable, with a few light guns, handled boldly, and kept constantly in action.

It is generally said that each false attack should have troops enough to follow up a success. But this, however desirable, would lead to a too great division of force. The same object may often be attained by a skilful posting of reserves.

7. The *real* attack is made by infantry, usually in close column, in silence, without firing, and with the greatest rapidity and vigor.

8. When a practicable breach has been opened in the work by our artillery, it is on this point that our assault should of course be directed. But where no breach exists, it will be best directed *on a salient;* the advances upon this part of a work being through a sector without fire.

9. When everything is ready, the assaulting column is sent forward *under cover of an artillery fire,* which is kept up to the last moment; that is, until our own troops would become exposed to it.

Nothing more completely demoralizes a garrison than a constant shower of shells on the interior of the work. In the attack on the Malakoff, at Sebastopol, the French kept pouring in, by a vertical fire from their batteries, a tremendous shower of shell till the moment of the assault; thus driving the Russians into their bomb-proofs. The assaulting column rushed in just as the last salvo was fired; carrying the work with the loss, as before stated, of only eleven men.

10. The march of the troops in advancing to the assault should be usually in *close column by division;* never by the flank, which would require too much time to be converted into any compact formation on meeting the enemy.

But where the assaulting troops are obliged to clear any considerable space of open ground exposed to the fire of the work, in order to diminish, as far as possible, their loss, by the way, they had better advance in three deployed lines, at three hundred yards apart, as was done by our assaulting force at Fort Fisher. In the attack on an intrenchment, such an order of march is not obnoxious to the serious objections applicable to it when used against an enemy in the open field.*

11. When the column approaches the work, a battery should be so posted as to *cover its retreat,* if repulsed.

12. As soon as the stormers arrive at the ditch, and also, whenever they are brought to a stand by any obstacle, *the detachment of sharpshooters should instantly deploy,* to divert the defenders' attention, and keep them down from the parapet, and also to shoot the gunners through the embrasures. If the stormers are checked before arriving at the ditch, the sharpshooters use such cover as they may find, or else fire lying down. So soon as they have arrived at the ditch, the sharpshooters

* Vide Tactical Use of the Three Arms, p. 9. Van Nostrand, New York.

should deploy along the crest of the counterscarp. Light guns on the flanks of the column would be useful for the same purpose, unless too much exposed.

This is a much better expedient than to let the leading files of the storming column open fire to cover the workmen. When troops have once halted and commenced firing, it requires time to make them stop their fire and move on; and by this delay the *élan* of the assault is in great danger of being lost.

The great importance of keeping down the fire from the parapet by a separate detachment of sharpshooters was shown in our attack of January, 1865, on Fort Fisher; in which the navy column of two thousand men, in assaulting the sea-front, was driven back with severe loss by a musketry fire from the work, in consequence of the marines, who were charged with this duty, having failed to perform it.

Again: During the siege of Knoxville, in November, 1863, the Confederate General Longstreet made a desperate assault on Fort Sanders with a brigade of chosen troops, two other brigades being held in support. The assaulting column had broken through the abatis and wire entanglements, and filled the whole ditch with men. But all their attempts to climb the parapet being repulsed by the musketry fire of the defenders poured into them from above, while, at the same time, the ditch was being swept by the guns on the flanks, and lighted shells thrown over from the work, they finally surrendered.

Two hundred dead and wounded of the assailants lay in the ditch, and the ground in front of it was also strewed with them. We captured over one thousand stand of arms and three battle flags, while our loss was only eight killed and five wounded.

It is manifest that one chief cause of the failure of this assault was the fire of the defenders from the parapet, from which they must have been driven if a heavy line of sharpshooters had been used for that purpose.

13. If the ditch be *not over six feet deep*, the men can jump down and help each other up. If over this depth, ladders may be planted, or else fascines, or sand-bags may be used to fill it up; or the counterscarp may be dug away for the same purpose.

14. The stormers will make at once for the *nearest re-entering angle;* which, as before explained, will usually be a dead angle, sheltered from the defenders' fire; where they will rally and form, and then all mount on the parapet together by scaling ladders; or else, will first make a breach in the parapet with their tools, or by mining and blowing it down.

15. The assailants, by *tying haversacks round their heads*, will partially protect themselves from the stones, logs, &c., rolled down on them from the parapet.

At our assault of the works at Vicksburg, in 1863, our soldiers sometimes took up the lighted shells thrown among them while in the ditch, and threw them back over the parapet to explode among the enemy.

16. It is of great importance to silence *the guns on the flanks* that rake the ditch. For this purpose, skirmishers thrown out from the flanks of the column as it enters the ditch will sometimes be able to rush up into the shelter of a dead angle, and watching for the moment when the gunners are reloading, spring up and dispatch them, and capture or at least spike the guns.

17. *Loaded shells* may be fired into the parapet, to crumble it down, and thus form a ramp to ascend by; or the same object may be accomplished by undermining the foot of the scarp with the pick.

18. Just before climbing the parapet, the leading stormers may throw over it hand grenades, in order, by their explosion, to *clear it of defenders.*

But these grenades are sometimes picked up by the garrison and thrown back again, to explode in the ditch; as was done by the Confederates in our assault of June 14th, 1863, on the defences at Port Hudson.

19. The most important requisite in an assault is *a united attack* at the decisive moment. Let the troops mount on the berm together, with as wide a front as possible, and wait there till all is ready; then all leap into the work at once.

On gaining the parapet, the assailants should instantly face to the right and left, and charge the defenders in flank. If met in front by the enemy's reserve, they should rush on it impetuously, and drive it back with the bayonet.

20. If the defenders *retreat to a work in the rear*, it will be important to keep at their heels, so as to rush into it pell-mell with them; for, by this means, the rear work may be carried also; whereas, if it be not, the work just carried may be made untenable by the fire of the one in the rear. This has been sometimes, however, prevented by the rapidity with which the assailants have obtained cover by throwing up an épaulement.

21. If the work attacked has *an open gorge*, and we are able to gain it, it will, of course, obviate the necessity of an attack in front. At all events, cavalry, or skirmishers, if the ground favor the movement, might be sent round to suddenly enter the gorge, while the rest of the troops are attacking in front.

22. Such arrangements should be made as to prevent the wounded being brought back *through the advancing columns*. The attempt to do this through a narrow covered way, by which our troops were debouching in Burnside's assault at Petersburg, caused great delay and confusion.

23. When it has become evident *that the assault will fail*, not a moment should be lost in withdrawing the columns, in order to prevent unnecessary sacrifice of life. Troops and guns should be rapidly thrown forward and actively used to cover the retreat.

C.—Attack on Lines of Intrenchment.

1. Where *one work commands another*, the work commanding should be the one first carried. First, because, until this is done, the work commanded, though captured, would not be tenable by us; and secondly, possession of the work commanding would soon secure to us all those commanded by it.

Thus, at our siege of Monterey, in the Mexican war, after we had stormed and carried the work on the crest of the Loma de Federacion, and had turned its guns on the work below it at the foot of the hill, this lower one could hold out no longer, and was captured immediately; as was also the Bishop's Palace, as soon as we had carried the work on the crest of the hill behind it.

2. In the case of a *double bridge-head*, the interior of each work is necessarily exposed to the other; so that the carrying of one of them will generally insure the capture of the other.

Thus, in 1812, the bridge of Almaraz, over the Tagus, was occupied by the French, and defended by a bridge-head at each extremity. An English detachment, under General Hill, having surprised the one on the left bank and captured it by escalade, the bridge-head opposite was compelled to surrender also.

3. The weak point in a line of intrenchments, as in a line of troops, is its flank. *A flank once forced or turned*, unless the works be redoubts, and so, defensible on all sides, *the whole line must fall.*

Thus, in February, 1862, the narrow passage called Croatan Sound, a sea entrance into North Carolina, was defended by a series of Confederate forts on Roanoke Island, which shuts in the Sound on the east. The channel opposite these forts, and under their fire, was obstructed by piles and sunken vessels, behind which were stationed several Confederate gun-boats. The Federal General Burnside landed his force at some distance below the southernmost of the line of forts. The only defence of that flank toward which we were marching was a three-gun fort or battery erected across the main road which led up the island, and commanding it for a considerable distance. Directly in front of the little work was a pond of water, and on each side of the road, extending beyond both flanks of the fort, there was a densely wooded swamp, so deep as to be considered impassable. Nevertheless, two of our regiments having succeeded, with great difficulty, in making their way through the swamp on our left, suddenly debouched on some cleared ground behind the right flank of the work, and opened fire upon it. The fort being entirely defenceless in rear, the garrison hastily retreated up the road, carrying with them the troops in support; our troops pursuing. From this moment, all the forts beyond became unavailable against us; since our march would lead us directly upon their rear, and we would take them in reverse. Consequently, on the capture of this small fort on their left flank being known, all the other works

were immediately abandoned by their garrisons. The result was the capture of six forts, with forty guns, over two thousand prisoners (the rest having escaped to the main-land), and three thousand small arms.

So, at Fort Donelson, in the same month of February, 1862, the Federal General C. F. Smith's division having carried a certain position on the right of the Confederate works, which would enable him to turn them all, and attack them in reverse, the garrison, consisting of some fifteen thousand men, thought themselves compelled to surrender.

4. The capture of one of the retired works in a system of intrenchments would generally be followed by decisive results; for it would enable us to carry all those other works which the captured work either commands or would take in reverse. But such a work cannot be reached without running the gauntlet of concentrated cross-fires from front and flanks; and the operation is, therefore, so dangerous that it is a general rule *not to attack a re-entrant*, but rather a salient in a line of intrenchments.

The rule, however, would not properly apply, where

(1.) The carrying of a particular position at a re-entrant would probably lead to the possession of the whole system of works; and where

(2.) The fire from the adjacent works may be avoided by making the attack a surprise.

Thus in Burnside's attack on the Petersburg lines,

in July, 1864, the intrenched crest of Cemetery Hill, which was at a re-entrant of the lines, had such a command over the other intrenchments that the carrying of it would probably lead to the capture of the other works, and of Petersburg itself. To avoid the formidable cross-fires an assaulting column would have to undergo in penetrating to this point, a mine of vast dimensions, reaching under the enemy's advanced works, was sprung just before the assault began, in order to obtain, by its paralyzing effect, the advantage of a surprise. The plan, which was both judicious and bold, failed only in consequence of unforeseen accidents in its execution.

5. The most favorable point of attack in front is at some *gap in the line*, whether left by the enemy, or made in it by our bombardment, or by the explosion of mines. To make our attack more sure to result in some important and permanent advantage, it should be directed, when practicable, upon some point within the lines, the possession of which would lead to further successes.

6. The attack itself should consist of *three elements:*

(1.) A storming column, to rush forward with the utmost celerity to carry the objective point; without stopping, when the assault is a surprise, to manœuvre, or even to preserve its formation.

(2.) A strong detachment on each flank, to cover the flanks and rear of the storming column, by sweeping down the enemy's line to the right and left.

(3.) A reserve, near enough to make success complete, or to cover the retreat, as the case may require.

7. The attack should be *supported*—

(1.) By an incessant and overwhelming artillery fire upon the interior of the enemy's line for some distance on each side of the gap; in order to prevent the part attacked from being re-enforced from other parts of the line; the fire to commence when our assaulting columns move forward, and to cease when they have passed through the gap, and our troops are about to sweep down the enemy's line.

(2.) By a vigorous charge in front, upon the parts of the line adjacent to the gap, while our other troops are taking them in flank. Even if, owing to obstacles in the way, this front attack should amount only to a demonstration, its result would hardly be less decisive.*

8. If the storming column has succeeded in occupying the ground at or near the objective point, but has not found shelter within an enemy's work, it should lose no time in *securing its position by intrenching*, in order to obtain a base for further successes. For this reason, it should always be accompanied by engineer officers, with a working party, carrying intrenching tools and materials, such as picks, shovels, axes, gabions, and sandbags.

In the attack supposed, the storming column will need

* Vide Tactical Use of the Three Arms, p. 115. Van Nostrand, New York.

support for its flanks from the moment it has passed the enemy's advanced line. It must therefore *not precede* the troops destined for this service, but must either have them on its flanks, or else march behind them; to rush forward on their change of direction to sweep down the lines.

10. As to the best formation for such an attack:

(1.) The *storming troops* should be in double column by division, closed in mass; being thus equally ready to charge, or to deploy to the front.

(2.) The flanking troops, *if they precede* the storming column, should march in two columns, side by side, each doubled on the centre at half distance; from which formation the tactical transition to a march in line to the left or right is prompt and easy.

(3.) If the flanking troops march *side by side* with the storming column, and the space be too narrow for the march of three columns abreast, they may march by the flank.

(4.) If the flanking troops are to sweep down the enemy's lines, not in line, but *in column*, they should march by the flanks of subdivisions of a simple column closed in mass; the transition from which to a close column of attack would be made by a mere facing.

(5.) When the flanking troops march by the flank, the march should be by that flank which, on their facing into line, will not bring the *rear rank in front;* and when they march in column, it should be so formed as not to

bring them into line *by inversion;* since, troops being seldom or never perfectly at home in these formations, they might impair their confidence, and lead to confusion.

11. *Cavalry* cannot usually be employed, either with safety or effect, among intrenchments; for it is liable to be defeated by mere obstacles of ground. It is, therefore, generally repulsed when sent against field works, unless as a support to infantry.

XV.—Of the Defence.

1. When we are *equal or superior* in number to the enemy, it is unwise to intrench; for,

(1.) It dispirits the troops by the idea it gives them of their inferiority.

(2.) It more or less cramps their movements; making it difficult to follow up a repulse into a victory.

2. To this rule there are *exceptions;* as

(1.) Where we have raw or demoralized troops to oppose to a disciplined enemy.

(2.) Where, from the nature of the country, it may be necessary to intrench in order to guard against surprise.

(3.) Where the ground is so difficult or obstructed as to isolate, in a measure, a particular corps from the rest of the army; to enable it to hold its ground until support arrives.

3. Intrenchments are sometimes said to *quadruple* the passive strength, or power of resistance, of the

defenders; that is, that 1,000 men behind intrenchments are equivalent to 4,000 assailants in the open field. The chief element of this superiority is the trifling loss the defenders, covered by their parapets, should sustain, compared with the severe loss they can inflict on their assailants.

Napoleon said that, by means of intrenchments, 50,000 men, with 3,000 artillerymen, should be able to defend an open city against an army of 300,000 men; meaning, of course, for a certain limited time.

4. *When an attack is expected*, we must use the strictest vigilance to guard against surprise, especially at night. Pickets and sentinels should be thrown forward to watch the approaches; and patrols should be kept constantly out to prevent their being reconnoitred by the enemy.

5. If the enemy approach the work at night, throw out *light-balls*, to light up the ground about the work. These are made of an incendiary composition which burns with a vivid light.

In our late war, calcium lights were used with success for this purpose, and also, as before stated, as a substitute for fire-balls in the attack.

At the siege of Knoxville, the Confederates having assaulted one of our works in a dark night, a signal officer suddenly threw up showers of Roman candles, which, effectually illuminating the whole ground, showed our guns where to aim, and enabled us to repulse the attack.

6. Have *every officer and man thoroughly instructed* as to his post and his duty in case of attack; for any confusion among the garrison at the critical moment of the assault might be fatal.

7. The ground in the neighborhood should afford an enemy *no cover within range of our guns.* Therefore destroy all buildings, cut down or burn all woods, and level all fences which might shelter an enemy's battery or sharpshooters.

Where this is impracticable, place howitzers in such positions as to be ready to shell every cover in case of need.

8. *Heavy beams* may be placed on the parapet, resting upon sods, or sand-bags, so as to make loop-holes; to be afterwards rolled down upon the assailants in the ditch; as also stones, incendiary preparations, and loaded shells, through troughs placed on the superior slope.

9. It is *essential to a vigorous defence,* that the troops should be drawn up in two ranks on the banquette; and that there be also a strong reserve drawn up on the terre-plein.

10. A *sortie* on the assaulting troops should be instantly made,

(1.) When any confusion or hesitation is observed among them;

(2.) On their being repulsed from the parapet; or

(3.) When their flanks or rear are exposed.

For a sortie, cavalry is the best arm, supported, when practicable, by horse artillery. If made by infantry, it is always with the bayonet.

But a small detachment should not make a sortie; thereby leaving a strong position to fight on unequal terms.

11. During the artillery fire from the work, as the labor of serving the guns, long continued, is very exhausting, the men should be divided into *three reliefs*, or sets, for that purpose.

12. The defenders *keep under shelter* at or near their posts during the assailants' cannonade, until it is obliged to cease, in order to allow their assaulting columns to approach the work; when they promptly man the parapet. The men are told to reserve their fire till the enemy arrives at a certain point, say from two hundred to five hundred yards from the parapet, according to the range of their fire-arms. This musketry fire should be very effective; and the defence then presents its most formidable phase.

13. When the defenders' artillery fire is *overmatched* by that of the assailants (which will generally be the case when the work forms a salient in a line of intrenchments, the enemy's guns surrounding it), the garrison, in order to save life and ammunition, should take shelter in their bomb-proofs, leaving but a thin line of troops at the parapet, to prevent the work being carried by a sudden dash. But the moment the assailants' cannonade has ceased, they should come out from their shelter;

else the enemy, rushing in, may be able to shut them up in them.

14. *Mines* are sometimes used as auxiliary to the defence; but they very seldom accomplish their object; as, from a variety of accidents, they either do not explode at all, or fail to explode at the precise moment required, in order to produce the intended effect.

15. The species of mine most conveniently used in the defence of field works is called a *fougass;* which is a small mine placed at the bottom of a shaft or pit, a few feet in depth.

(1.) A *common fougass* is placed in a shaft from three to ten feet deep.

(2.) A *shell fougass* consists of a box, divided horizontally into two parts, with a few pounds of powder in the lower part, and loaded shells in the upper one, with their fuses penetrating through an aperture into the powder below.

(3.) A *stone fougass*, or rock-mortar, is made by digging in the ground a pit six feet deep, inclined at an angle of forty-five degrees; the axis of the pit pointing outwards from the work. Throw into the pit fifty-five pounds of powder, covered with a wooden shield at least six inches thick. Over this throw three or four cubic yards of pebbles, weighing not less than half a pound each. Over this, again, heap earth, kept firm by a revetment of sods. The explosion of this mine will scatter stones over an area with a radius of thirty or forty yards.

(4.) The *best position* for a fougass is in front of a salient, or other weak point; and at such a distance beyond the ditch as to prevent the counterscarp from being injured by the explosion.

(5.) The greatest care and precision are required, in order to explode the mine at the proper moment; which is only when the enemy is *actually over it.*

(6.) The mine is *fired* from the work, by means of a fuse or powder-hose communicating with the powder in the mine; or by a wire connected with the trigger of a loaded musket, the muzzle of which is in the priming; or by a wire connecting with a galvanic battery; or by a rocket.

When a fuse is employed, it should be continuous, or in as few pieces as possible. Spliced fuses are unreliable, the fuse being apt to die out at the point of splicing. The explosion will be, of course, more sure, if several parallel fuses or wires are employed, instead of a single one.

The mines or torpedoes used by the Confederates in their defence of Fort Fisher contained each 100 pounds of powder. They were laid 200 yards in front of the land face, 80 yards apart; and were connected with the work by sets of wires. But not one of them exploded in the assault, the shells fired from the fleet having cut all the wires in two.

16. If the enemy be allowed time to recover from the panic and confusion generally caused by the explosion of a mine, it will have availed nothing for the defence.

The moment, therefore, the explosion has taken place, he should be *charged with the utmost vigor.*

17. The *whole extent of the parapet should be defended* by either cannon or musketry; else there would be loss of time and confusion in running from one point to another to repel an attack.

18. The *reserve* is drawn up on the terre-plein, ready to charge the enemy the moment he enters the work; or to cover the retreat, if the defenders should be driven from it.

19. Raw troops, seeing the enemy not repulsed by their distant fire, are apt to become intimidated at the very moment that the assailants, in crossing the ditch and climbing the parapet, are in disorder, and unable to use their weapons. Whereas, when the assailants leap into the ditch, the defenders should at once *mount on the parapet*, and receive them with the bayonet or the butt of the musket. This will be the most effectual way of repelling the assault.

The means of mounting on the parapet may be stout pickets driven into the tread of the banquette, and used as steps.

Experience has proved the bayonet to be the surest reliance for the defence at this moment. In using it, the assailed have the benefit of the moral force acquired by becoming the assailants, are fresher than the climbing enemy, and have the advantage of position.

20. But, if the defenders have to *retire to another work*

in rear, this must be done before the enemy reaches the ditch, so as to prevent his entering pell-mell with them into the rear work. So in defending a bridge-head, if a retreat is necessary, it should be made in time to prevent the enemy from getting on the bridge and crossing it with the defenders; thus paralyzing the works in rear.

21. Where the guns used in an intrenchment *belong to a field battery*, the horses of which are at hand, and the defenders are driven from the work, they should try to carry off the guns with them.

At the battle of Heilsburg, in the campaign of 1807, the Russians being driven from a redoubt by the assault of a French regiment, the commander drew off his guns at a gallop, promptly planted them at a point commanding the interior of the redoubt, and covered the French with grape, which made great havoc and confusion among them; seeing which, other Russian troops rushed in and recaptured the redoubt.

22. If the garrison have *an interior redoubt* in good condition to retire into, the loss of the main work should not dishearten them; for, from this citadel, while completely sheltered from fire themselves, they will be able to pour down on the assailants a destructive plunging fire, that ought to drive them from the work.

23. In *abandoning* an intrenchment, if there is no time to carry off the guns, they should, at least, be spiked. The ammunition that cannot be saved should be thrown

into a well or cistern, or set fire to by means of a train, and blown up.

24. The *defence of a Line of Intrenchments* must obviously vary with the mode and circumstances of the attack. Being liable, therefore, to an indefinite number of contingencies, it would be impossible to lay down a complete system of rules on the subject. But the most important element in such a defence will always be *a strong movable force* kept massed at one or more points, from which it could be promptly thrown to any part of the line that may be attacked. By combining the principles herein laid down with those which relate to the tactical use of the three arms, we will readily understand how every species of attack on a line of intrenchments may be repulsed.

The fortifying of buildings and enclosures, the strengthening of natural defences and obstacles, and the improvement, for these purposes, of the various materials everywhere to be found, involve too many details for classification, or even for mention in this work. But the general principles that have now been explained, once mastered, will enable any intelligent officer to extemporize, in all localities whatsoever, the best possible means of defence, according to the circumstances of the case.

THE END.

D. VAN NOSTRAND,

192 BROADWAY,

HAS RECENTLY PUBLISHED

A TREATISE

ON THE

TACTICAL USE OF THE THREE ARMS.

BY FRANCIS J. LIPPITT,

BREVET BRIGADIER-GENERAL UNITED STATES VOLUNTEERS, LATE COLONEL SECOND CALIFORNIA INFANTRY; AUTHOR OF "A TREATISE ON INTRENCHMENTS."

---

1 *Vol.* 12*mo*, *Cloth.* $1.25.

NOTICES.

"The author discusses the advantages and disadvantages of the various modes of forming, posting and using troops, and illustrates his statements by pertinent references to military history, with which he evinces great familiarity. His illustrations are drawn mainly from the history of Napoleon's campaigns, and from the experiences in our recent war."—*Providence Journal.*

"We have thoroughly learned the science of war, and treatises now written upon any department are from a very practical stand-point. This work, by a brave officer, gives in a small space some very excellent rules and hints, that, though not soon to be practically used, are nevertheless proper to be known."—*Boston Evening Gazette.*

From the Army and Navy Journal.

"Col. Lippitt has prepared a well-written, terse, clear, intelligible, and very interesting treatise upon some tactical questions which have always been of importance since the introduction of gunpowder into the science of war, and the distribution of active field forces in three main arms.

"A good idea of the system of the book may be gained from an account of the subjects it treats. The first of these is the practical use of Infantry. This general head includes, first, the whole topic of attacks, in general, in the formation, and in the manner of making them, with a discussion of bayonet charges. To these latter, the author is very partial, and not without reason. He fortifies his position by illustrations drawn from Leipsic (the one of 1813), Austerlitz, Mill Springs, Seven Pines, Malvern Hill, Chattanooga. He could have added authority from many writers, had that been his method.

"But to proceed with the analysis. We next find considered the defences of Infantry—against other Infantry, against Artillery, against Cavalry, with some criticism upon all the defensive formations, but particularly upon squares. Next comes the subject of Skirmishers—their use, their positions, the handling of them, and the rules for individual skirmishers.

"In the same lucid way, the practical use of Artillery is treated. First, there comes the posting of artillery, with respect to the ground, to our own troops, to the enemy, and to the other position of pieces in the same battery. Next, the use of Artillery in general—in offensive combat; and defensive combat; against the three arms, severally. Lastly, its fire and its supports. Upon Cavalry, he divides his observations into its formations—its strong and its weak points; the method of posting it; its supports; how used; how it fights; its charge; its attack on Infantry, both generally and on squares."

"The formation, the manner of use, and the general handling, are very practically presented, and we are glad to see that, while many of the illustrative examples are taken from the Napoleonic wars, our own war has not been neglected. We recommend this book for use as a simple, accurate, and brief manual in military institutions, and for instruction in militia organization."—*United States Service Magazine.*

"A great want has always been felt in military schools, in drill clubs, and in camps of instruction, of some brief manual which should show the relation borne to each other by the three arms, in combined operations. Col. Lippitt has admirably filled this need. Many an officer has come to grief, in actual service, for want of that knowledge which this little volume would have given him."—*Boston Commonwealth.*

The Edinburgh Review quotes from the "Tactical Use of the Three Arms," as one of the military authorities of the age. It says that the work "is understood to convey the pith of the lessons gained by the experience of the Union Armies in three years' constant service."

Letter from Gen. Burnside.

STATE OF RHODE ISLAND, EXECUTIVE DEPARTMENT,
PROVIDENCE, *Oct.* 14, 1866.

MY DEAR SIR: Please accept my thanks for your book on the "Tactical Use of the Three Arms." I have looked over it with great interest, and take pleasure in saying that I regard it as a most useful work, and one destined to take a high stand in military literature. It would not surprise me to hear of its being adopted as a text-book at West Point.

Truly yours,

(Signed) A. E. BURNSIDE.

Gen. FRANCIS J. LIPPITT.

Letter from the Duke of Cambridge.

BRITISH LEGATION, WASHINGTON, D. C.,
May 25, 1866.

SIR: I have the honor to transmit to you, for delivery to Colonel Lippitt, a copy of a letter which has been forwarded to me by the Earl of Clarendon from His Royal Highness the Field Marshal Commanding-in-Chief, conveying to Colonel Lippitt his Royal Highness' best thanks for the copy of a work, entitled "Tactical Use of the Three Arms," presented to him by the author.

I am, Sir,

Your most obedient humble servant,

(Signed) FREDERICK W. A. BRUCE.

Hon. C. SUMNER.

HORSE GUARDS,
11*th May*, 1866.

SIR: I have received through Mr. Hammond, of the Foreign Office, the copy of a work, entitled "Tactical Use of the Three Arms," by Colonel Lippitt, late Second Infantry California Volunteers, which you forwarded for my acceptance, and I have now therefore to request that you will be good enough to take an early opportunity of conveying to Colonel Lippitt, through Mr. Sumner, the expression of my best thanks for his having presented to me so interesting and useful a book on the subject in which I naturally take very great interest.

I am, Sir,

Yours,

(Signed) GEORGE.

The Hon. Sir F. W. A. BRUCE, G. C. B.

AUTHORIZED U. S. INFANTRY TACTICS.

For the Instruction, Exercise, and Manœuvres of the Soldier, a Company, Line of Skirmishers, Battalion, Brigade, or Corps d'Armée. By Brig.-Gen. SILAS CASEY, U. S. A. 3 vols., 24mo. Cloth, lithographed plates. $2.50.

VOL. I.—School of the Soldier; School of the Company; Instruction for Skirmishers.

VOL. II.—School of the Battalion.

VOL. III.—Evolutions of a Brigade; Evolutions of a Corps d'Armée.

WAR DEPARTMENT, WASHINGTON, *August* 11, 1862.

The System of Infantry Tactics prepared by Brig.-Gen. Silas Casey, U. S. A., having been approved by the President, is adopted for the instruction of the Infantry of the Armies of the United States, whether Regular, Volunteer, or Militia, with the following modifications, viz.:

First, That portion which requires that two companies shall be permanently detached from the battalion as skirmishers, will be suspended.

Second, In Title First, Article First, the following will be substituted for Paragraph 6, viz.:

"A regiment is composed of ten companies, which will be habitually posted from right to left in the following order; first, sixth, fourth, ninth, third, eighth, fifth, tenth, seventh, second, according to the rank of Captain."

EDWIN M. STANTON,
Secretary of War.

MORRIS'S INFANTRY TACTICS.

Comprising the School of the Soldier, School of the Company, Instruction for Skirmishers, School of the Battalion, Evolutions of the Brigade, and Directions for Manœuvring the Division and the Corps d'Armée. By Brig.-Gen. WILLIAM H. MORRIS, U. S. Vols., and late U. S. Second Infantry. 2 vols. 24mo, cloth. $2.00.

* * * "General Morris's work on 'Infantry Tactics,' is one of the most valuable of the numerous compilations of the kind which have appeared since the commencement of the war. * * * The manner in which instructions are conveyed, is entitled to the highest praise. It is divested of all superfluities of language, and is terse, clear, and easily comprehensible."—*N. Y. Herald.*

* * * "He [Gen. Morris] has preserved the grain and blown away the immense amount of chaff in the form of intricate and spectacular evolutions."—*N. Y. Times.*

* * * General Morris, after consultation with distinguished tacticians, has discarded many of the details heretofore employed in infantry operations; every thing is made as plain and comprehensive as the nature of the subject admits: and although the evolutions and manœuvres which he sets forth are especially adapted to districts where the roads are narrow and where woods, swamps, and other obstacles to rapid movements abound, the system is equally applicable to an open country, and, indeed, is to be recommended for general use on account of its superior simplicity and the celerity of movement which it involves."—*N. Y. Tribune.*

SYSTEMS OF MILITARY BRIDGES,

In Use by the United States Army; those adopted by the Great European Powers; and such as are employed in British India. With Directions for the Preservation, Destruction, and Re-establishment of Bridges. By Brig.-General GEORGE W. CULLUM, Lieut.-Col. Corps of Engineers, United States Army. 1 vol., octavo. With numerous Illustrations. cloth. $3.50.

"It is a trite remark that of all the operations of war none is more difficult and hazardous than the passage of a large river in the presence of a bold and active enemy. The importance to this country of such a work as the present, when our armies have to pass so many great rivers, cannot be over-estimated. We have no man more competent to prepare such a work than Brigadier-General Cullum, who had the almost exclusive supervision, devising, building, and preparing for service of the various bridge-trains sent to our armies in Mexico during our war with that country. The treatise before us is very complete, and has evidently been prepared with scrupulous care. The descriptions of the various systems of military bridges adopted by nearly all civilized nations are very interesting even to the non-professional reader, and to those specially interested in such subjects must be very instructive, for they are evidently the work of a master of the art of military bridge-building."—*Washington Chronicle.*

MILITARY BRIDGES,

For the Passage of Infantry, Artillery, and Baggage-Trains; with suggestions of many new expedients and constructions for crossing streams and chasms; designed to utilize the resources ordinarily at command and reduce the amount and cost of army transportation. Including also designs for Trestle and Truss Bridges for Military Railroads, adapted especially to the wants of the Service of the United States. By HERMAN HAUPT, Brig.-Gen. in charge of the construction and operation of the U. S. Military Railways, Author of "General Theory of Bridge Construction, &c." Illustrated by Sixty-nine Lithographic Engravings. Octavo, cloth, $6.50.

"This elaborate and carefully prepared, though thoroughly practical and simple work, is peculiarly adapted to the military service of the United States. Mr. Haupt has added very much to the ordinary facilities for crossing streams and chasms, by the instructions afforded in this work."—*Boston Courier.*

BENTON'S ORDNANCE AND GUNNERY.

A Course of Instruction in Ordnance and Gunnery; compiled for the use of the Cadets of the United States Military Academy, by Capt. J. G. BENTON, Ordnance Department, late Instructor of Ordnance and Gunnery, Military Academy, West Point. Principal Assistant to Chief of Ordnance, U. S. A. Second Edition, revised and enlarged. 1 vol., 8vo, clo, cuts. $5.00.

"We cannot commend this work too highly, both for the substance it contains, and the highly finished manner in which it has been issued by the publisher. There is no one book within the range of our military reading and study, that contains more to recommend it upon the subject of which it treats. It is as full and complete as the narrow compass of a single volume would admit, and the reputation of the author as a scientific and practical artillerist is a sufficient guarantee for the correctness of his statements and deductions, and the thoroughness of his labors."—*N. Y. Observer.*

"A GREAT MILITARY WORK.—We have before us a bound volume of nearly six hundred pages, which is a complete and exhaustive 'Course of Instruction in Ordnance and Gunnery,' as its title states, and goes into every department of the science, including gunpowder, projectiles, cannon, carriages, machines, and implements, small arms, pyrotechny, science of gunnery, loading, pointing, and discharging fire-arms, different kinds of fires, effects of projectiles and employment of artillery. These severally form chapter heads and give thorough information on the subjects on which they treat. The most valuable and interesting information on all the above topics, including the history, manufacture, and use of small arms is here concentrated in compact and convenient form, making a work of rare merit and standard excellence. The work is abundantly and clearly illustrated."—*Boston Traveller.*

INSTRUCTIONS FOR FIELD ARTILLERY.

Prepared by a Board of Artillery Officers.

To which is added the EVOLUTIONS OF BATTERIES, translated from the French, by Brig.-General R. ANDERSON, U. S. A. 1 vol. 12mo, 122 Plates. Cloth, $3.00.

"WAR DEPARTMENT,
"WASHINGTON, D. C., *March* 1, 1863.

"This system of Instruction for Field Artillery, prepared under direction of the War Department, having been approved by the President, is adopted for the instruction of troops when acting as field artillery.

"Accordingly, instruction in the same will be given after the method pointed out therein; and all additions to or departures from the exercise and manœuvres laid down in the system, are positively forbidden.

"EDWIN M. STANTON,
"Secretary of War."

THE ARTILLERIST'S MANUAL:

Compiled from various Sources, and adapted to the Service of the United States. Profusely illustrated with woodcuts and engravings on stone. Second edition, revised and corrected, with valuable additions. By Gen. JOHN GIBBON, U. S. Army. 1 vol., 8vo, half roan. $6.

This book is now considered the standard authority for that particular branch of the Service in the United States Army. The War Department, at Washington, has exhibited its thorough appreciation of the merits of this volume, the want of which has been hitherto much felt in the service, by subscribing for 700 copies.

"It is with great pleasure that we welcome the appearance of a new work on this subject, entitled 'The Artillerist's Manual,' by Capt. John Gibbon, a highly scientific and meritorious officer of artillery in our regular service. The work, an octavo volume of 500 pages, in large, clear type, appears to be well adapted to supply just what has been heretofore needed to fill the gap between the simple Manual and the more abstruse demonstrations of the science of gunnery. The whole work is profusely illustrated with woodcuts and engravings on stone, tending to give a more complete and exact idea of the various matters described in the text. The book may well be considered as a valuable and important addition to the military science of the country."—*New York Herald.*

HAND-BOOK OF ARTILLERY,

For the Service of the United States Army and Militia. Eighth edition, revised and greatly enlarged. By Col. JOSEPH ROBERTS, U. S. A. 1 vol., 18mo, cloth. $1 25.

The following is an extract from a Report made by the committee appointed at a meeting of the staff of the Artillery School at Fort Monroe, Va., to whom the commanding officer of the School had referred this work:

* * * "In the opinion of your Committee, the arrangement of the subjects and the selection of the several questions and answers have been judicious. The work is one which may be advantageously used for reference by the officers, and is admirably adapted to the instruction of non-commissioned officers and privates of Artillery.

"Your Committee do, therefore, recommend that it be substituted as a text-book in place of 'Burns' Questions and Answers on Artillery.'"

(Signed,) I. VOGDES, *Capt. 1st Artillery.*
(Signed,) E. O. C. ORD, *Capt. 3d Artillery.*
(Signed,) J. A. HASKIN, *Bvt. Maj. and Capt. 1st Artillery.*

AUSTRIAN INFANTRY TACTICS.

Evolutions of the Line as practised by the Austrian Infantry, and adopted in 1853. Translated by Capt. C. M. WILCOX, Seventh Regiment, U. S. Infantry. 1 vol., 12mo. Three large plates, cloth. $1.

THE PRINCIPLES OF STRATEGY AND GRAND TACTICS.

Translated from the French of General G. H. DUFOUR. By WILLIAM P. CRAIGHILL, Capt. of Engineers U. S. Army, and Assistant Professor of Engineering, U. S. Military Academy, West Point. From the last French Edition. Illustrated. In one volume, 12mo. cloth. $3.

"General Dufour is a distinguished civil and military engineer and a practical soldier, and in Europe one of the recognized authorities on military matters. He holds the office of Chief of the General Staff of the Army of Switzerland."—*Evening Post.*

"This work upon the principles of strategy, the application of which we have sorely stood in need of in all our campaigns, comes from an acknowledged authority. It was General Dufour who successfully arrayed the Federal Army of Switzerland against secession, and "subdued" the rebellious Cantons."—*Boston Journal.*

HEAVY ARTILLERY TACTICS.—1863.

Instruction for Heavy Artillery; prepared by a Board of Officers, for the use of the Army of the United States. With service of a gun mounted on an iron carriage. In one volume, 12mo, with numerous illustrations. cloth. $2.50.

"WAR DEPARTMENT,
"WASHINGTON, D. C, *Oct.* 20, 1862.

"This system of Heavy Artillery Tactics, prepared under direction of the War Department, having been approved by the President, is adopted for the instruction of troops when acting as heavy artillery."

EDWIN M. STANTON,
Secretary of War.

U. S. TACTICS FOR COLORED TROOPS.

U. S. Infantry Tactics, for the Instruction, Exercise, and Manœuvres of the Soldier, a Company, Line of Skirmishers, and Battalion, for the use of the COLORED TROOPS of the United States Infantry. Prepared under the direction of the War Department. 1 volume, 24mo. plates. cloth. $1.50.

"WAR DEPARTMENT, WASHINGTON, *March* 9, 1863.

"This system of United States Infantry Tactics, prepared under the direction of the War Department, for the use of the Colored Troops of the United States Infantry, having been approved by the President, is adopted for the instruction of such troops."

EDWIN M. STANTON, Secretary of War.

ARMY OFFICERS' POCKET COMPANION.

Principally designed for Staff Officers in the Field. Partly translated from the French of M. DE ROUVRE, Lieutenant-Colonel of the French Staff Corps, with Additions from standard American, French, and English Authorities. By WM. P. CRAIGHILL, First Lieutenant U. S. Corps of Engineers, Assist. Prof. of Engineering at the U. S. Military Academy, West Point. 1 vol., 18mo, full roan. $2 00.

"I have carefully examined Capt. CRAIGHILL's Pocket Companion. I find it one of the very best works of the kind I have ever seen. Any Army or Volunteer officer who will make himself acquainted with the contents of this little book, will seldom be ignorant of his duties in camp or field."

H. W. HALLECK, Major-General U. S. A.

"I have carefully examined the 'Manual for Staff Officers in the Field.' It is a most invaluable work, admirable in arrangement, perspicuously written, abounding in most useful matters, and such a book as should be the constant pocket companion of every army officer, Regular and Volunteer."

G. W. CULLUM, Brigadier-General U. S. A.
Chief of General Halleck's Staff, Chief Engineer Department Mississippi.

MANUAL FOR ENGINEER TROOPS.

Consisting of

Part I. Ponton Drill.
II. Practical Operations of a Siege.
III. School of the Sap.
IV. Military Mining.
V. Construction of Batteries.

By Major J. C. DUANE, Corps of Engineers, U. S. Army. 1 vol., 12mo, half morocco, with plates. $2 50.

"I have carefully examined Capt. J. C. Duane's 'Manual for Engineer Troops,' and do not hesitate to pronounce it the very best work on the subject of which it treats."

H. W. HALLECK, Major-General, U. S. A.

"A work of this kind has been much needed in our military literature. For the army's sake, I hope the book will have a wide circulation among its officers."

G. B. MCCLELLAN, Major-General, U. S. A.

VIELE'S HAND-BOOK.

Hand-Book for Active Service, containing Practical Instructions in Campaign Duties. For the use of Volunteers. By Brig.-Gen. EGBERT L. VIELE, U. S. A. 12mo, cloth. $1.

EVOLUTIONS OF FIELD BATTERIES OF ARTILLERY.

Translated from the French, and arranged for the Army and Militia of the United States. By Gen. ROBERT ANDERSON, U. S. A. Published by order of the War Department. 1 vol., cloth, 32 plates. $1.

SERGEANT'S ROLL BOOK, FOR THE COMPANY, DETAIL AND SQUAD.

Pocket-book form. $1.25.

STANDING ORDERS OF THE SEVENTH REGIMENT, NATIONAL GUARD.

For the Regulation and Government of the Regiment in the Field or in Quarters. By A. DURYEE, Colonel. New Edition, flexible cloth. 50 cents.

LIGHT INFANTRY COMPANY AND SKIRMISH DRILL.

The Company Drill of the Infantry of the Line, together with the Skirmish Drill of the Company and Battalion, after the method of General LE LOUTEREL. Bayonet Fencing; with a Supplement on the Handling and Service of Light Infantry. By J. MONROE, Colonel 22d Regiment, N. G., N. Y. S. M., formerly Captain U. S. Infantry. 1 vol., 32mo. 75 cents.

FIELD TACTICS FOR INFANTRY,

Comprising the Battalion movements, and Brigade evolutions, useful in the Field, on the March, and in the presence of the Enemy. The tabular form is used to distinguish the commands of the General, and the commands of the Colonel. By Brig.-Gen. WM. H. MORRIS, U. S. Vols., late 2d U. S. Infantry. 18mo, Illustrated. 75 cents.

SWORD-PLAY.

The Militiaman's Manual and Sword-Play without a Master.—Rapier and Broad-Sword Exercises copiously Explained and Illustrated; Small-Arm Light Infantry Drill of the United States Army; Infantry Manual of Percussion Muskets; Company Drill of the United States Cavalry. By Major M. W. BERRIMAN, engaged for the last thirty years in the practical instruction of Military Students. Second edition. 1 vol., 12mo, red cloth. $1.

A SYSTEM OF TARGET PRACTICE.

For the use of Troops when armed with the Musket, Rifle-Musket, Rifle, or Carbine. Prepared, principally from the French, by Captain HENRY HETH, 10th Infantry, U. S. A. 18mo, cloth. 75 cents.

SCHOOL OF THE GUIDES.

Designed for the use of the Militia of the United States. Flexible cloth. 60 cents.

FRENCH'S GRAMMAR.

Grammar. Part of a Course on Language. Prepared for Instruction in the U. S. Corps of Cadets. By Rev. J. W. FRENCH, D. D., Professor of Ethics and English Studies in the United States Military Academy, West Point. 1 vol., 12mo, cloth. $2.50.

FRENCH'S ETHICS.

Practical Ethics. By Rev. J. W. FRENCH, D. D., Professor of Ethics, U. S. Military Academy. Prepared for the Use of Students in the Military Academy. 1 vol., 8vo, cloth. $4.50.

MANUAL FOR QUARTERMASTERS AND COMMISSARIES.

Containing Instructions in the Preparation of Vouchers, Abstracts, Returns, &c., embracing all the recent changes in the Army Regulations, together with instructions respecting Taxation of Salaries, etc. By Captain R. F. HUNTER, late of the U. S. Army. 12mo, cloth. $1 25 Flexible morocco, $1.50.

COOKE'S CAVALRY TACTICS;

Or, Regulations for the Instruction, Formations, and Movements of the Cavalry of the Army and Volunteers of the United States. 100 illustrations, 12mo. Paper, 75 cents; cloth, $1.00.

THE VOLUNTEER QUARTERMASTER.

Containing a Collection and Codification of the Laws, Regulations, Rules and Practices governing the Quartermaster's Department of the United States Army, and in force March 4, 1865. By By Captain ROELIFF BRINKERHOFF, Assistant Quartermaster U. S. Volunteers, and Post Quartermaster at Washington. 1 vol., 12mo, cloth. $2.50.

This work embraces all the laws of Congress, and all the orders and circulars of the War Office and its bureaus, bearing upon the subject. It also embodies the decisions of the Second Comptroller of the Treasury, so far as they affect the Quartermaster's Department. These decisions have the force of law in the adjustment of accounts, and are therefore invaluable to all disbursing officers.

ARMY PAY DIGEST, AND READY CALCULATOR; OR, REGIMENTAL PAY TABLE.

Compiled by Major EZRA WEBB. Octavo, cloth. $2.

RIFLES AND RIFLE PRACTICE.

An Elementary Treatise on the Theory of Rifle Firing; explaining the causes of Inaccuracy of Fire and the manner of correcting it; with descriptions of the Infantry Rifles of Europe and the United States, their Balls and Cartridges. By Capt. C. M. WILCOX, U. S. A. New edition, with engravings and cuts. Green cloth. $2.00.

"Although eminently a scientific work, special care seems to have been taken to avoid the use of technical terms, and to make the whole subject readily comprehensible to the practical enquirer. It was designed chiefly for the use of Volunteers and the Militia: but the War Department has evinced its approval of its merits by ordering from the publisher one thousand copies for the use of the United States Army."—*Louisville Journal.*

NEW BAYONET EXERCISE.

A New Manual of the Bayonet, for the Army and Militia of the United States. By Colonel J. C. KELTON, U. S. A. With Forty beautifully-engraved plates. Red cloth. $2.00.

This Manual was prepared for the use of the Corps of Cadets, and has been introduced at the Military Academy with satisfactory results. It is simply the theory of the attack and defence of the sword applied to the bayonet, on the authority of men skilled in the use of arms.

The Manual contains practical lessons in Fencing, and prescribes the defence against Cavalry, and the manner of conducting a contest with a Swordsman.

"This work merits a favorable reception at the hands of all military men. It contains all the instruction necessary to enable an officer to drill his men in the use of this weapon. The introduction of the Sabre Bayonet in our army renders a knowledge of the exercise more imperative."—*New York Times.*

TACTICAL USE OF THE THREE ARMS.

Infantry, Artillery, and Cavalry. By FRANCIS J. LIPPITT, Ex-Colonel Second Infantry, California Volunteers. 1 vol., 12mo. Red cloth. $1.25.

A TREATISE ON INTRENCHMENTS.

By Francis J. Lippitt, Brevet Brigadier-General U. S. Volunteers Author of Tactical Use of the Three Arms.

SIEGE AND REDUCTION OF FORT PULASKI, GEORGIA.

Papers on Practical Engineering. No. 8. Official Report to the U. S. Engineer Department of the Siege and Reduction of Fort Pulaski, Ga., February, March, and April, 1862. By Brig.-General Q. A. GILLMORE, U. S. A. Illustrated by Maps and Views. 1 vol., 8vo, cloth. $2 50.

"This is an official history of the siege of Fort Pulaski, from the commencement, with all the details in full, made up from a daily record, forming a most valuable paper for future reference. The situation and construction of the Fort, the position of the guns both of the rebels and the Federals, and their operation, are made plain by maps and engraved views of different sections. Additional reports from other officers are furnished in the appendix, and every thing has been done to render the work full and reliable."—*Boston Journal.*

GILLMORE'S FORT SUMTER.

Official Report of Operations against the Defences of Charleston Harbor 1863. Comprising the Descent upon Morris Island, the Demolition of Fort Sumter, and the Siege and Reduction of Forts Wagner and Gregg. By Major-General Q. A. GILLMORE, U. S. Volunteers, and Major U. S. Corps of Engineers. With 76 Lithographic Plates, Views, Maps, &c. 1 vol. 8vo, clo. $10. Half Russia. $12.

"General Gillmore has enjoyed and improved some very unusual opportunities for adding to the literature of military science. and for making a permanent record of his own professional achievements. It has fallen to his lot to conduct some of the most striking operations of the war, and to make trial of interesting experiments in engineering and artillery, which were both calculated to throw light upon some of the great points of current discussion in military art, and also to fix the attention of spectators in no ordinary degree.

"His report of the siege of Fort Pulaski thus almost took the form of a popular scientific treatise; and we now have his report of his operations against Forts Wagner and Sumter, given to the public in a volume which promises to be even more attractive at bottom, both to the scientific and the general reader, than its predecessor.

"The reports of General Turner, Gillmore's Chief of Artillery, and those of Major Brooks and Colonel Serrel, his engineers, and of other officers, accompany the principal report, forming appendices of great value and interest, and presenting many details which could not be given by the commanding general. The volume is illustrated by seventy-six plates and views, which are admirably executed, and by a few excellent maps; and indeed the whole style of publication is such as to reflect the highest credit upon the publishers."
—*Boston Daily Advertiser.*

A TREATISE ON MILITARY SURVEYING.

Theoretical and Practical, including a description of Surveying Instruments. By G. H. MENDELL, Captain of Engineers. 1 vol. 12mo with numerous Illustrations. cloth. $2.

"The author is a Captain of Engineers, and has for his chief authorities Salneuve, Lalobre, and Simms. He has presented the subject in a simple form, and has liberally illustrated it with diagrams, that it may be readily comprehended by every one who is liable to be called upon to furnish a military sketch of a portion of country."—*New York Evening Post.*

MANUAL OF INSTRUCTIONS FOR MILITARY SURGEONS,

In the Examination of Recruits and Discharge of Soldiers. With an Appendix containing the Official Regulations of the Provost Marshal General's Bureau, and those for the formation of the Invalid Corps, &c., &c. Prepared at the request of the United States Sanitary Commission. By JOHN ORDRONAUX, M. D., Professor of Medical Jurisprudence in Columbia College, New York. 12mo. Half morocco. $1.50.

"The author has drawn his materials from the best accredited sources of information and the highest authorities in both hemispheres. He selects France and Prussia, as the representative military nations of Europe, and he has adopted as closely as possible their order of instruction on the subjects of the enlistments and discharges of soldiers; and, in the form of an Appendix, he has embodied the Code of Instructions relating to the U. S. Army, adopted by the Board of Medical Officers, convened at Washington for that purpose, on the 15th of April, 1863, to which are also added the Regulations governing the formation of our Invalid Corps. Nothing of importance to army surgeons has been omitted."—*Army and Navy Gazette.*

HINTS ON THE PRESERVATION OF HEALTH IN ARMIES.

For the use of Volunteer Officers and Soldiers. By JOHN ORDRONAUX, M. D. New edition, 18mo, cloth. 75 cents.

RIFLED ORDNANCE:

A Practical Treatise on the Application of the Principle of the Rifle to Guns and Mortars of every calibre. To which is added, a new theory of the initial action and force of Fired Gunpowder. By LYNALL THOMAS, F. R. S. L. Fifth edition, revised. One volume, octavo, illustrated. cloth. $2.

"An important contribution to a branch of military science, which is just now a subject of warm discussion in America as well as England. Mr. Thomas's conclusions are based on a large number of careful experiments, and are entitled to careful considerations. In regard to the famous Armstrong guns, while, considering their inventor as entitled to the honor of suggesting the only successful method of constructing wrought iron guns, he disagrees with him in nearly all that relates to the projection of the shot, and holds that the Armstrong must still be an experimental gun—particularly objectionable as breech-loaders. Its asserted overcoming of the scientific and mechanical difficulties of other guns, are based wholly on its revival of breech-loading—a method generally considered obsolete and objectionable.

THE AUTOMATON REGIMENT; OR, INFANTRY SOLDIERS' PRACTICAL INSTRUCTOR.

For all Regimental Movements in the Field. By G. DOUGLAS BREWERTON, U. S. Army. Nearly put up in boxes, price $1; when sent by mail, $1. 40.

THE AUTOMATON COMPANY; OR, INFANTRY SOLDIERS' PRACTICAL INSTRUCTOR.

For all Company Movements in the Field. By G. DOUGLAS BREWERTON, U. S. A. Price in boxes, $1.25; when sent by mail, $1.95.

THE AUTOMATON BATTERY; OR, ARTILLERISTS' PRACTICAL INSTRUCTOR.

For all Mounted Artillery Manœuvres in the Field. By G. DOUGLAS BREWERTON, U. S. A. Price in boxes, $1; when sent by mail, $1. 40.

PATTEN'S ARMY MANUAL.

Containing Instructions for Officers in the preparation of Rolls, Returns, and Accounts required of Regimental and Company Commanders, and pertaining to the Subsistence and Quartermaster's Departments, etc., etc. 1 vol., 8vo, cloth. $2.00.

PATTEN'S ARTILLERY DRILL. 1 vol., 12mo, paper. 50 cents.

PATTEN'S INFANTRY TACTICS,

Contains Nomenclature of the Musket; School of the Company; Skirmishers, or Light Infantry and Rifle Company Movements; School of the Battalion; Bayonet Exercise; Small-Sword Exercise; Manual of the Sword or Sabre. 12mo, 100 Engravings, paper (revised edition). 75 cents.

PATTEN'S INFANTRY TACTICS.

Containing Nomenclature of the Musket; School of the Soldier; Manual of Arms for the Rifle Musket; Instructions for Recruits, without regard to Arms; School of the Company; Skirmishers, or Light Infantry and Rifle Company Movements; the Bayonet Exercise; the Small-Sword Exercise; Manual of the Sword or Sabre. 12mo, 92 Engravings, paper. 50 cents.

PATTEN'S CAVALRY DRILL.

Containing Instructions on Foot; Instruction on Horseback; Basis of Instruction; School of the Squadron, and Sabre Exercise. 93 Engravings, 12mo, paper. 50 cents.